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SAFT-UT Utilities

Reference Manual

T. E. Hall

October 1987

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CONTENTS

1.0 INTRODUCTION

This manual is intended to give the user a complete command and operation reference for using the SAFT-UT utilities in the VMS environment. It augments two additional documents, the GUIDE TO SAFT-UT PRINCIPLES AND CONVENTIONS and the INTERFACE AND INSTALLATION GUIDE. An understanding of the contents of the GUIDE TO SAFT-UT PRINCIPLES AND CONVENTIONS is a recommended prerequisite to the use of the SAFT-UT utility programs.

2.0 OVERVIEW OF THE SAFT-UT OPERATING ENVIRONMENT

Once the user has logged into an account that supports the SAFT-UT utility environment, the full set of user programs are available to perform SAFT data analysis. There are a variety of utilities available to support SAFT processing. These may be divided into four major catagories: general, preprocessing, processing, and graphics. There are additional unsupported and undocumented utilities developed by the UofM prior to the PNL implementation. These rely on operator knowledge and/or review of supplied source code.

In addition to this written document, reference is available on-line with the supplied 'help' facility. The user may type

```
$ HELP @SAFT
```

to review a list of the utility set, or

```
$ HELP utility_name
```

will display a general description of the selected utility.

Each command driven SAFT utility has on-line 'help' available to the user during the interactive session. After invoking a utility, one may retrieve general help information for the utility by entering HELP, or specific commands by entering the command name as a parameter in the HELP command request. For example in an APLOT session:

```
<APLOT> HELP
```

or `<APLOT> HELP PLOT`

The following sections discuss each supported SAFT-UT utility, outlining its specific operation, and giving a detailed description of commands and options where applicable.

The notation for the syntax description is as follows:

1) Required characters for proper commands are capitalized.

2) Parameters enclosed in brackets [] are optional.

3) The '|' character is used as a logical exclusive 'or' operator for parameter entry.

A syntax description example is as follows:

```
EXAmple   [ parm1 | parm2 ]
```

The first three letters of the EXAMPLE command uniquely describe it, so entry of these first three letters is all that is necessary to invoke it. No parameters are necessary, but if a parameter is desired then PARM1 or PARM2 are to be entered on the command line, not both.

3.0 GENERAL UTILITIES

3.1 DHEAD

DHEAD displays on the VMS SYS$OUTPUT device (typically the user's terminal) the parameter information located in the 'header' of a given SAFT formatted file (data, processed, or envelope).

syntax: DHEAD [saft_filename]

3.2 PHEAD

The PHEAD program submits the 'header' information of a given SAFT formatted file (data, processed, or envelope) to the SAFT system printer (preassigned as logical name of SAFTPRINT).

syntax: PHEAD [saft_filename]

4.0 PREPROCESSING UTILITIES

4.1 CSTAT

Invoking the CSTAT utility will calculate the file statistics (min,max,avg) for the specified input SAFT format file. A-scan record related statistics are also calculated.

syntax: CSTAT [saft_filename]

4.2 DEDIT

This SAFT utility provides a means to modify file header information and individual data values in a SAFT format file. This utility is referred to as the 'SAFT data file editor', because it allows the user to edit any portion of the specified file.

This program is command driven (after being invoked, various commands may be entered to perform specific tasks). Information regarding specific commands is provided in Section 7.3 of this document.

syntax: DEDIT [saft_filename]

4.3 DFDT

This utility calculates the derivative with respect to time of the input file contents, and puts the result in the specified output file. This is specifically provided to facilitate wide-band SAFT operations. It is normally performed on the unprocessed "raw" data file. The algorithm for calculating the derivative:

1) performs a complex DFT on the input data file,
2) multiplies this result by i and scale factors, and
3) performs the inverse OFT to obtain the final result.

reference: Bracewell, R., The Fourier Transform and Its Applications, 1965, McGraw-Hill, pp 122.

syntax: DFDT [input_filename] [output_filename]

4.4 DFJOIN

This utility allows the user to merge two data files. The files are merged assuming that they are contiguous in the Y direction. For example, they could be data acquired during the inspection of a pipe sample. Circumferentially, these two files, then, would be contiguous.

syntax: DFJOIN

4.5 DFTRIM

This utility allows the user to extract a subset of a given data file. The user is prompted for minimum and maximum values of the x,y and z dimensions that specify the boundaries of the subset to be extracted.

syntax: DFTRIM [input_filename] [output_filename]

4.6 DUMPAPT

DUMPAPT allows the user to display (or print) the contents of an existing aperture definition file. This file must have been made using either the GENAPT utility or the file "APERTURE.FIL", which is made automatically by the SAFT processing utilities. Selection of the -p option on the command line will cause the output to be spooled to the system printer with the logical name of SAFTPRINT.

syntax: DUMPAPT [-p] [saft_aperture_def_filename]

4.7 FILTER

This utility will perform a band-pass filter operation on the input file and place the results in the output file. The operator is prompted for the lower and upper cuttoff frequencies in MHz. The filter currently passes all frequencies within the band and rejects all frequencies outside the specified band. No Guassian weighting or other techniques are currently employed. The SPECTRUM command in the APLOT utility is handy to determine the desired cuttoff frequencies for filtering.

syntax: FILTER [input_filename] [output_filename]

4.8 GENAPT

This SAFT utility generates an aperture definition file. Normally an aperture file is formed automatically during processing, but this utility allows the user to tailor the receiver aperture to effect the processing performance.

This program is command driven (after being invoked, various commands may be entered to perform specific tasks). Information regarding specific commands is provided in Section 7.4 of this document.

syntax: GENAPT [saft_filename]

4.9 HALFX

This utility will read the input file, and generate an output file that contains half as many samples in the X direction. Every other A-scan is extracted from the original data set to form the result.

syntax: HALFX

4.10 HALFXY

This utility will read the input file, and generate an output file that contains half as many samples in both the X and Y directions. Every other A-scan and every other scan line is extracted from the original data set to form the result.

syntax: HALFXY

4.11 HALFZ

This utility will read the input file, and generate an output file that contains half as many samples in the Z direction. Every other sample point is extracted from the original data set to form the result.

syntax: HALFZ

4.12 REDUCE

The REDUCE utility converts a 16-bit (two byte) data file to the current single byte 8-bit format used in the SAFT utilities. A 16-bit data file consists of the identical SAFT data file format, but with each sample point a 16 bit integer. This program scales the input data set, by a factor based on the range of the full input file, to fit into a single byte integer for the output file. It is assumed that the input waveform is bipolar and undetected. The output file then becomes a standard SAFT data file. The user is prompted for an input and output filename.

syntax: REDUCE

4.13 SHUFFLEX

This SAFT utility flips, end-for-end, both X and Y axes. This is helpful if the incident angle of the scan configuration is positive and is desired to be negative and visa-versa.

syntax: SHUFFLEX [input_filename output_filename]

4.14 SHUFX

This SAFT utility flips, end-for-end, the X axis only. This is helpful if the incident angle of the scan configuration is positive and is desired to be negative and visa-versa.

syntax: SHUFX [input_filename output_filename]

4.15 SPECTRUM

This utility will perform a digital Fourier Transform operation on the input file and place the results in the output file.

syntax: SPECTRUM [input_filename output_filename]

4.16 SWAPXY

This SAFT utility swaps the X and Y axes. That is, the old X axis becomes the new Y axis; and the old Y axis becomes the new X axis. This is equivalent to rotating the coordinate system by 90 degrees. This is helpful if the incident angle is originally in the increment (Y) direction. The SAFT processing and graphics utilities expect the incident angle to be in the scan (X) direction.

syntax: SWAPXY [input_filename output_filename]

5.0 PROCESSING UTILITIES

5.1 ENVDET

This program performs envelope detection of the input data file using the Hilbert transform method. The result is placed in the specified output file.

syntax: ENVDET [input_file output_file]

5.2 ENVELOPE

This SAFT utility performs envelope detection on the input data or processed data file using the "sliding window" technique. This method is identical to that which will be performed if envelope detection is selected to be done in one of the processing modules. The result is placed in the specified output file.

syntax: ENVELOPE [input_file output_file]

5.3 FSAP

This SAFT utility performs Synthetic Aperture Processing in the PULSE-ECHO configuration on the host. The user will be prompted for all necessary parameters such as selective processing, envelope detection, etc. Each of these parameters is well described in the description of the SAFTPROC commands in Section 7.5 of this document. This utility may be invoked directly, or it may be spawned automatically as a sub-process, when host PULSE-ECHO processing is invoked while running the SAFTPROC utility.

syntax: FSAP

5.4 FTSAP

This SAFT utility performs Synthetic Aperture Processing in the TSAFT/TSAFT-2 configuration on the host. The user will be prompted for all necessary parameters such as selective processing, envelope detection, etc. Each of these parameters is well described in the description of the SAFTPROC commands in Section 7.5 of this document. This utility may be invoked directly, or it may be spawned automatically as a sub-process, when host TSAFT/TSAFT-2 processing is invoked while running the SAFTPROC utility.

syntax: FTSAP

5.5 RECTIFY

The RECTIFY utility performs a full-wave rectification of the input file. No envelope detection is performed. The input file should not have been detected prior to performing this function. The result is placed in the specified output file.

syntax: RECTIFY [input_file] [output_file]

5.6 RTFSAP

This SAFT utility performs Synthetic Aperture Processing in the PULSE-ECHO configuration on the REAL-TIME SAFT PROCESSOR (SAFTBOX). The user will be prompted for all necessary parameters such as selective processing, envelope detection, etc. Each of these parameters is well described in the description of the SAFTPROC commands in Section 7.5 of this document. This utility may be invoked directly, or it may be spawned automatically as a sub-process, when REAL-TIME PULSE-ECHO processing is invoked while running the SAFTPROC utility.

syntax: RTFSAP

5.7 RTFTSAP

This SAFT utility performs Synthetic Aperture Processing in the TSAFT/TSAFT-2 configuration on the REAL-TIME SAFT PROCESSOR (SAFTBOX). The user will be prompted for all necessary parameters such as selective processing, envelope detection, etc. Each of these parameters is well described in the description of the SAFTPROC commands in Section 7.5 of this document. This utility may be invoked directly, or it may be spawned automatically as a sub-process, when REAL-TIME TSAFT/TSAFT-2 processing is invoked while running the SAFTPROC utility.

syntax: RTFTSAP

5.8 SAFTPROC

The SAFTPROC utility is the nucleus of the SAFT processing group. It is the program normally implemented to perform SAFT processing. It provides a command driven tool for performing the SAFT processing. When this program is invoked, system defaults are initially established for processing parameters. These may be altered easily by selecting the appropriate command. The 'GO' command invokes a child process that will perform SAFT processing as specified by the selected parameters.

This program is command driven (after being invoked, various commands may be entered to perform specific tasks). Information regarding specific commands is provided in Section 7.5 of this document.

syntax: SAFT [saft_data_filename]

5.9 SQR

The SQR utility performs a square function on the data of the input file. The result is normalized and placed in the specified output file.

syntax: SQR

5.10 SQRT

The SQRT utility performs a square-root function on the data of the input file. The result is normalized and placed in the specified output file.

syntax: SQRT

6.0 GRAPHICS and ANALYSIS UTILITIES

6.1 APLOT

This SAFT utility performs extensive graphics functions on a Ramtek 9465 graphics processor. It is intended to provide a versatile analysis package, specifically tailored to SAFT applications, to aid in flaw detection, sizing and characterization.

This program is command driven (after being invoked, various commands may be entered to perform specific tasks). Information regarding specific commands is provided in Section 7.2 of this document.

The 'T' option will indicate that the selected file will be displayed in 'T-VIEW' mode. This display is from the transducer's view. See the APLOT help facility for a more extensive explanation of this feature.

The '-O' option will suppress screen erasure upon entry to the APLOT utility.

syntax: APLOT [saft_filename [T]] [-O]

6.2 CPLOT

This SAFT graphics utility displays a SAFT format file in data collection graphics format on a Ramtek 9465. It was originally written to be the graphics module of the NRC SAFT real-time system. As a result, this may be used to preview an output file (while processing is being performed) and observe results before completion of SAFT processing has occurred. If a data file is being processed on another terminal or in a batch queue, this program may be invoked to display the envelope (SAFT processed) file concurrently with the processing. This is especially handy with the processing of large data files.

This graphics program may also be used in a user's own data collection configuration. See the INTERFACE AND INSTALLATION GUIDE for information regarding simultaneous data collection, processing, and display.

syntax: CPLOT [saft_filename]

6.3 RESRAM

This SAFT utility restores image files to the Ramtek 9465. The files must have previously been generated using the SAVRAM utility or the SAVRAM command in APLOT.

syntax: RESRAM [image_filename]

6.4 SAVRAM

This SAFT utility 'saves' the current image on the Ramtek 9465, by copying the image to a file on disk. The image may be restored by invoking the RESRAM utility or using the RESRAM command in APLOT.

syntax: SAVRAM [image_filename]

6.5 TPLOT

This SAFT utility performs extensive graphics functions on a Tektronix 4105 terminal. It is intended to provide a versatile analysis package to aid in flaw detection, sizing and characterization.

This program is command driven (after being invoked, various commands may be entered to perform specific tasks). Information regarding specific commands is provided in Section 7.6 of this document.

syntax: TPLOT [saft_filename]

7.0 COMMAND DESCRIPTION OF INTERACTIVE SAFT-UT UTILITIES

7.1 COMMON COMMANDS AND ATTRIBUTES

Each one of the interactive (command driven) SAFT-UT utilities has a set of commands associated with it. Wherever possible these commands and the general characteristics of these programs have been standardized. There are a set of special characters that perform inherent functions, and a number of commands that perform exactly the same function from program to program. These will be described in this section.

CTRL/C
Terminates current command operation and working session.

CTRL/Y
Stops current command operation. This entry will cause control to be transferred to DCL and a '$' prompt will subsequently be displayed. If the user then enters the letter 'C' for 'continue' the control will be transferred back to the current session with all parameters retained. Prior to entering the 'C' command the operator may choose to use the DCL command 'SPAWN' to perform such functions as 'DIRECTORY' and the like. If this is done using the 'SPAWN' command, the current session is not lost and the user may return the session simply by entering the 'C' command.

Another way of doing the operation as described above is to use the '$' command during the current session. Simply enter '$ SPAWN' while in the utility and the parent process will spawn a child process that will spawn a subsequent child process. Control will be transferred to this second level and a DCL prompt will appear. At this point any correct DCL command may be entered. When the desired operation is complete, simply enter 'LOGOUT' and control will be restored to the original session (parent process).

$
The '$' character entered as a command allows the operator to execute any one line DCL command. This is intended to be handy when the user would like to do a 'DIRECTORY' command or 'SHOW SYSTEM' or similar commands like this. A subprocess is spawned to perform the specified command, so operations like 'SET DEF' will operate relative to the sub-process and will effectively do nothing. (Use the 'CDIR' command, described below, to perform the 'SET DEF' operation.) Commands like 'SHOW PROC' need to include the specific process in the command line, otherwise the default will be the spawned process performing the command. Control is passed to the child process, and the parent is placed in a state of hibernation until control is returned. This command may be used to invoke multiple layers of execution. For example, the use of the command '$ SPAWN' essen-

tially allows the user to enter into a sub-session. Also the user may choose to invoke another SAFT utility without terminating the current session (for example: '$ CSTAT' or '$ GENAPT').

```
syntax:   $ command_line
example:  $ DIRE/TOTAL/PROT  *.DAT
          $ SHOW MEM
          $ @COMFILE.COM
```

CDIR

Change the default directory to the specified directory. Upon termination of the program the default is reset to the original directory.

```
syntax:   CDIR  new_directory
example:  CDIR  DISK1:[SAFT.DATA]
AKA:      SDir, CHDir
```

EXit

Terminate program.

```
syntax:   EXit
example:  EX
AKA:      BYe, ENd, LOgout, Quit, STOp
```

File

Specify input data file name to be retrieved from disk for subsequent operations.

All utilities use the File command exactly the same, except APLOT. APLOT offers an addition 't' option on this command line. See the APLOT command description for further information.

```
syntax:   File input_file_name
example:  F sawcut.env
AKA:      GETf, Read
```

HEAder

Display file header information of current file.

```
syntax:   HEAder
example:  HEA
AKA:      DHeader
```

Help

Display the utility specific 'help' file. Help for individual commands may be specified by entering that command as the parameter.

syntax: Help [command]
example: H file

PHELP

Print complete utility specific HELP file to the system printer.

syntax: PHELP
example: PHELP
AKA: HELP/P, PRINTHelp

7.2 APLOT

APLOT Conventions and Overview:

It helps somewhat in the effective operation of APLOT to understand the application for which APLOT was written. This utility was designed to assist in the interpretation of SAFT results acquired in the inspection of circumferential pipe welds and/or nuclear pressure vessels. If angle beam inspection was implemented, it is assumed that the incident angle occurs along the scan (axial,X) axis. The transducer is scanned along the axial or X axis and incremented along the circumferential or Y axis. A weld-center-line arrow is positioned in the plotted images assuming the weld runs parallel to the circumferential or Y axis.

The origin of the plotted axes in nearly ALL views are located in the UPPER left-hand corner. This is especially important to remember when viewing C-scan or T-view projections. An exception to this is when a positive incident angle is present. Then the origin of the XZ (B-scan side view) of the selected volume is in the upper right-hand corner.

APLOT compresses all planes within the selected image volume by plotting the highest intensity value along a given projection. Thus a high intensity feature, within the selected volume, may obscure the viewing of lower intensity features for a particular projection. Multiple views, the SEQUENCE command, the BOX command, and the X,Y,Z commands are available to the user to assist in image interpretation.

All presentations normalize the displayed data by the maximum value present in the selected volume. The user may use the NORM command to modify this, or the CURNORM command may be used to normalize the display by the value present at the cursor location.

ALL CURSOR operations must be performed on the last projection plotted even if multiple views are present on the screen. Cursor operations are NOT allowed on COMPARE mode presentations.

Other important features of APLOT include:

- multiple color/gray scales
- dual file presentation (compare feature)
- transducer view (T-VIEW) projection
- cursor command for sizing
- intensity normalization

VMS syntax:

```
$ APLOT  [file_name [T]]  [-O]
```

CTRL/Y

This special character may be used to terminate a lengthy command, such as PLOT, COMP, SEQ, etc. At times a user may have a change of heart and decide not to continue a PLOT operation, for example. Entry of CTRL/Y and subsequently a 'c' for continue will bring the session back to the <APLOT> prompt without loss of the session parameters.

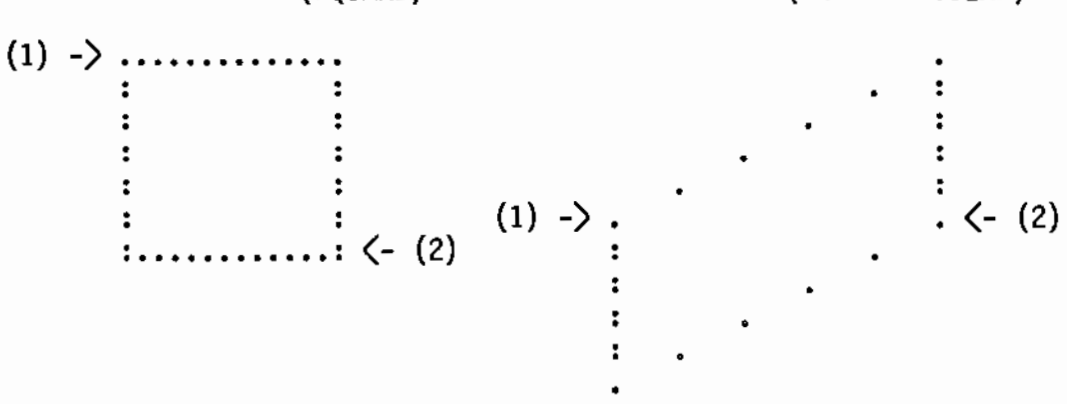
ASCAN

Plot the contents of a single ascan on the graphics device. The x and y coordinates may be entered (in points) as parameters or the sequential A-scan number. The number of data points to be plotted may be adjusted using the 'Z' or 'BOX' commands.

```
syntax: Ascan [x_coord y_coord] | [ascan_number]
example:  A 23 56
          A 456
```

BOX

This command initiates the box mode. It allows the user to either specify a subset "box" using the cursor control or explicitly specify the "box" using the command line. The cursor mode requires that the "visual" cursor switch be "on" and that two points be selected (by pressing the "enter" switch) on the latest image displayed. These two points define the box that will specify the image subset desired. The following diagrams indicate these definitions depending on whether the box to be drawn is "square" (default) or "perpendicular" to the insonification angle (see PERP command description for more information). Use the UNBOX command to restore full scan dimensions.



The cursor option is assumed when no parameters are on the BOX command line. The other alternative to specifying the box is specific entry of the x and y coordinates of points (1) and (2) on the command line. These values are the graphics coordinates for the specific image. The PHEADER command will display the current graphics parameters corresponding to the last plotted image.

syntax: BOx [x1 y1 x2 y2]
example: BOX (CURSOR)
BOX 20 20 40 40

COLOR

Place default color scale in color look-up table. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for related configuration information.

syntax: COlor
example: CO

COLOR0

Place black & white (gray) scale in color look-up table. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for relate configuration information.

syntax: COLOR0
example: COLOR0
AKA: BW

COLOR1

Place (UofM) color scale in color look-up table. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for related configuration information.

syntax: COLOR1
example: COLOR1

COLOR2

Place blended color scale in color look-up table. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for related configuration information.

syntax: COLOR2
example: COLOR2

COLOR3

Sets color look-up table to the contour scale. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for related configuration information.

syntax: COLOR3
example: COLOR3
AKA: CONtour, CONTR

COLOR4

Place CONTINUOUS black & white (gray) scale in the color look-up-table. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for related configuration information.

syntax: COLOR4
example: COLOR4
AKA: BW2

COLOR5

Place LOGARITHMIC black & white (gray) scale in the color look-up-table. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for related configuration information.

syntax: COLOR5
example: COLOR5
AKA: BW3, BWPHoto

COLOR6

Place the SIX color scale in the color look-up table. If the RESRAM command has been invoked just prior to this command then the operator will be prompted for related configuration information.

syntax: COLOR6
example: COLOR6

COMMENTS

This command allows the user to enter a 74 character comment line to be displayed at the bottom of the display screen. This is particularly helpful for documentation purposes as it will be saved when an image file is created using the SAVRAM command, or when a hard copy is generated from the image on the screen. After this command is invoked, the user is prompted for the line to be entered. If no change is desired to the comment line, then enter only a <CR> with no character.

syntax: COMMent
example: COMM

COMPARE

This command sets APLOT into the "compare" mode of display. This mode will display two independent files on the upper and lower part of the screen. Each image set includes the xz and yz views. The "color" parameter is an integer corresponding to the COLORn commands. That is, if the color_number parameter is 3 it utilizes the same color table as the COLOR3 command would invoke. The -O option will suppress erasure of the screen prior to plotting.

```
syntax:   COMpare  [t | b] [color_num] [-O]
example:  COMP b 3
          COMP 2
```

To clarify the COMPARE command operation the following examples and explanations are given:

<APLOT> COMP	Plot the current image on the top half of screen if this is the first COMP command issued. Otherwise alternate top and bottom halves depending on which half was plotted last. The color table is assumed to be that which was previously defined or default.
<APLOT> COMP T	Plot the current image on the top half of the screen. Default or previous look up table is used.
<APLOT> COMP B	Plot the current image on the bottom half of the screen. Default or previous look up table is used.
<APLOT> COMP N	Plot the current image alternating top and halves of the screen depending on what has previously been used. Use color table defined as in command COLORn.
<APLOT> COMP T n	Plot the current image on the top half of the screen. Use color table defined as in command COLORn.
<APLOT> COMP B n	Plot the current image on the bottom half of the screen. Use color table defined as in command COLORn.

CURNORM

Normalize the current image displayed by the value at the position of the cursor. The "visible" switch on the Ramtek cursor control must be "on". Press the "enter" switch at the location that the desired the normalization is to occur. To exit the command set the "visible" switch to "off" and press the "enter" switch. NOTE that this command operates only on the latest image written to the screen.

syntax: CURNorm
example: CURN
AKA: CNOrm

CURSOR

Read the amplitude of the data at the position of the cursor. The current position of the cursor is also read. The cursor 'visible' switch must be 'on'. Press the 'enter' switch on the cursor control and the values will be displayed on the terminal. Exit this mode by placing the 'visible' switch to 'off' and pressing the 'enter' switch on the cursor control. NOTE that this command works only on the latest image written to the screen.

syntax: CUrsor
example: CU
AKA: CURAmp, CAMp, CURPos, CPOs

CURSIZE

Enter "cursor" mode for sizing. If BLINKING switch on cursor is ON then the difference between the first location entered and latest location entered will be presented on the terminal. If the BLINKING switch on the cursor control is OFF then the difference between the latest two entries will be typed to the terminal. To EXIT "cursor" mode turn "visible" switch on cursor control off, and press the "enter" switch on the cursor control. NOTE that this command works only on the latest image written to the screen.

syntax: CURSize
example: CURS
AKA: CSIze, CURDiffer, CDIffer, SIZE

ERASE

Erase the screen.

syntax: ERase
example: ER
AKA: CLear

EVEN

Forces the images on the left and right of the screen to be scaled the same. This feature is for both "plot" and "compare" modes.

syntax: EVen
example: EV

FILE

Specify input data file name to be retrieved from disk for subsequent display. The optional parameter 'tview' or just 't' after the file name is used to look at data from the transducer's point of view. Another way of thinking of TVIEW is that the display is as if viewed down the ends of the A-scans, from the transducer's point of view (Actually APLOT makes no axes transformations when this option is selected).

syntax: File input_file_name [Tview]
example: F IGSCCFLAW.ENV
F TESTFILE.ENV T
AKA: GETf, Read

NORMAL

Normalize data by specified data range.

syntax: NOrmal min max
example: NO 0 127

PARAMETERS

Display file parameters.

syntax: PArameters
example: PA

PAUSE

Pause specified number of seconds and then return. This command is primarily used for a delay feature in command procedures (e.g. as in a demonstration sequence) to reduce the speed in which sequential features are displayed.

syntax: PAUSE seconds
example: PAUSE 5

PERPENDICULAR

Enter "perpendicular" mode for future "BOX" and plot related commands. This tells APLOT to draw parallelograms in the XZ view that are parallel to the insonofication angle instead of the scan axes. Be sure to issue the "UNPerpendicular" command when perpendicular operations are complete.

syntax: PERpendicular
example: PER

PHEADER

Display parameters to be used for plotting the image.

syntax: PHeader
example: PH

PLANE

Select the plane to be displayed with the subsequent PLOT command. The xy, xz, or yz planes may be selected. The xz plane will be plotted on the left portion of the screen. The xy & yz planes will be plotted on the right side of the screen.

syntax: PLane XZ | YZ | XY
example: PL YZ

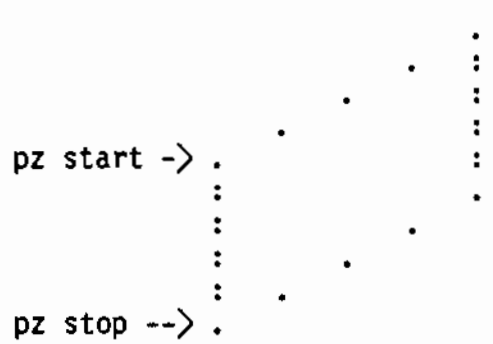
PLOT

Plot current file to Ramtek. The view to be plotted should previously be defined by the PL or RESET commands. This command will erase the screen if a new file has been selected, or if the normal "plot" mode is being entered from the "compare" mode. Selection of the -O will suppress this action.

syntax: PLOt [-O]
example: PLO
AKA: Build, Go, Putf, Write

PZ

This command is valid only for "perpendicular" mode situations. It sets the "PZ START" and "PZ STOP" values similar to the X,Y,Z commands.



syntax: PZ pz_start pz_stop
example: PZ 25 56

RESET

Performs the same function as the PLANE command, but also resets the graphics parameters x,y,z limits to default values (i.e. the full image boundaries are restored) and resets to standard plotting mode (i.e. not perpendicular mode).

```
syntax:   RESEt  XZ | YZ | XY
example:  RESET  YZ
```

RESRAM

Restore image from a file previously made by the SAVRAM command or the SAVRAM stand alone utility. The "-b" option selects blanking of the image until the full restoration is complete. The specified image file name will be displayed on the screen after the image has been restored.

```
syntax:   RESram [-b] filename
example:  RES IMAGE.SRM
AKA:      RESToreram
```

SAVRAM

Copies the display screen buffer to the specified image file for future retrieval using the RESRAM command.

```
syntax:   SAVram filename
example:  SAV IMAGE.SRM
AKA:      SAVeram
```

SEQ

Sequence plane-by-plane through the image. The sequence operation is determined by the most recent view plotted and latest view that has been selected by the PLANE command. Its increment occurs along the axis orthogonal to the plane selected with the PLANE command. If a YZ image has been most recently displayed and a box has been drawn to define a subset of this image, then SEQ may be invoked to sequence through XZ planes limited to those defined by the box drawn. This is done by issuing a PL XZ command and then the appropriate SEQ command. For example:

```
<APLOT> PLANE YZ
<APLOT> PLOT
<APLOT> BOX        * select area of interest on YZ view with
                     cursor.
<APLOT> PLANE XZ
<APLOT> SEQ 1
```

If no box is drawn the full volume will be sequenced through. The SEQ command, in other words, uses the data as displayed in the PARA command to determine which view it will sequence and which planes to sequence. The "incr" parameter determines the step size of the increment and is a mandatory parameter. The "compression" parameter determines how many planes will be included to form the image. If the "compression" parameter is not included a value equal to "incr" is assumed. The compression value must be less than or equal to the increment value.

syntax: SEQ incr [compression]
example: SEQ 2 1

SPECTRUM

Plot the frequency spectrum of a single ascan on the graphics device. A lo-pass filter factor may be selected to reduce the 'grass' on the plot and smooth the resulting plot. This factor must be between 0 and 1. A cuttoff frequency of (filter_fact)*(f_high) will be used. Where f_high is the highest frequency component in the plot. Default is filter_fact = 1.0 or in other words no filtering will occur. A normalization factor, max_plot, may be used to define a specific value in which to normalize the plot by. If no value is entered the plot is normalized by the maximum value of the data present in the chosen spectrum. This option is useful when one is comparing spectrums of a set of a-scans, so that one may choose to normalize the set of spectrums by a constant value. A subset of points of the input a-scan may be selected by the 'Z' or 'BOX' command. This allows one to determine the spectrum of one portion of the a-scan of interest.

syntax: SPECtrum x y [filter] [max_plot]
(or) SPECtrum ascan_number
example: SPEC 23 56 .1
SPEC 456

UNBOX

This command resets lateral limits placed on x,y,z to the full image values. Thus subsequent plotting will display the full image and not a subset.

syntax: UNBox
example: UNB

UNEVEN

Allows APLOT to automatically adjust image scaling such that the right hand image may be scaled independent of the left hand image. This will scale for maximum utilization of the screen. This feature may be used for both "plot" and "compare" modes.

syntax: UNEven
example: UNE

UNNORMALIZE

Negates the 'NORMAL' command. This command sets the data range equal to the default values, where min & max become the original values in the data file.

syntax: UNNormalize
example: UNN

UNPERPENDICULAR

Enter default "square box" mode for "BOX" and plot related commands.

syntax: UNPerpendicular
example: UNP

UNZOOM

Utilize the full resolution of the graphics device (1024 x 1280). For low resolution monitors this command effectively does nothing.

syntax: UNZoom
example: UNZ

X

Specify subset of X planes to be plotted. If the 'i' option is specified then the planes are to be given in units of inches; otherwise, the units are sample points.

syntax: X [I] start_plane end_plane
example: X 0 23
X I 0.0 2.3

XYSCALE

Provides a means to force rescaling of the x and y graphics axes of the image that was most recently presented. The numx and numy factors are multiplication factors, where the approximate zoom in the appropriate direction is numx+1 or numy+1. So if the graphics x axis is to be expanded by 2 simply enter "XYS 1,0". So the command "XYS 0,0" is an effective nop, i.e. it will plot the original image. NOTE: this command does not simply change the parameter, it will plot the new image.

syntax: XYScale numx numy
example: XYS 1 1

Y

Specify subset of Y planes to be plotted. If the 'i' option is specified then the planes are to be given in units of inches; otherwise the units are sample points.

```
syntax:   Y [I]  start_plane  end_plane
example:  Y 40 80
          Y I 4.0 8.0
```

Z

Specify subset of Z planes to be plotted. If the 'i' option is specified then the planes are to be given in units of inches; otherwise the units are sample points.

```
syntax:   Z [I]  start_plane  end_plane
example:  Z 56 789
          Z I 1.0 5.5
```

ZOOM

Zoom to one quarter the graphics area (512 x 640). For systems with low resolution monitors this command effectively does nothing.

```
syntax:   ZOom
example:  ZO
```

$\sin^{-1}$ [58400.0 / 108000.0 * sin(38)] = 19.45 degrees.

VMS syntax:

$ DEDIT [file_name]

ANGLEDIRECTION

Modify the direction the transducer is tilted off the normal. The entry must be 'x' or 'y' only.

syntax: ANGLEdirection [newdirection]
example: DIR x
AKA: DIRection, SQUINTDirection

BEAMANGLE

Modify full angle of the beam within the material as specified in the data file header. Units are degrees.

syntax: BEAMAngle [newangle]
example: BEAMA 12.5
AKA: BAngle

CLEARDEFFLAG

This command clears any A-scan record defect flags that have been previously defined by either the DEF or NODEF command. Regions specified by this command are neither defect areas nor non-defect areas; rather they are unknown or indeterminant regions.

Regions specified are in the 'y' (circumferential) direction. All A-scan records in the 'x' (axial) direction that are included in the specified range will be cleared. This does not effect the SAFT processing, but is useful for performing advanced spectral analysis using statistical methods.

The 'y_min' and 'y_max' arguments define the lower and upper bounds of the desired region of interest. The 'i' option allows these values to be entered in inches; otherwise the units are sample points.

syntax: CLEARDefflag [I] y_min y_max
example: CLEARD 12 14
CLEARD I 1.23 2.56

COMMENTS

Modify the comment text in the file header. The system allows the user to enter two 40 character lines of text. If this text is desired to be modified, then enter this command. Both lines of text will be displayed as they currently exist in the header. The user is prompted to enter the first 40 character line. If no change is desired on this line enter

7.3 DEDIT

DEDIT Conventions and Overview:

This utility provides a mechanism to manually edit a SAFT format data file. One may edit the data file header or choose to edit particular A-scan data records. To edit a specific record (A-scan and its local header) first use the GETRECORD command to specify which one. Then the DATA and DISPLAY commands may be used to modify that record.

The user may wish to review the detailed description of the SAFT data file header block in Section 6.1 of the INTERFACE AND INSTALLATION GUIDE for a complete explanation of each parameter this utility edits.

This utility also provides a method for flagging known defect areas and known non-defect areas. This is useful when applying possible future utilities to a given database for statistical analysis and trends. The commands that are related to this are: CLEARDEFFLAG, DEFECTFLAG, NODEFECTFLAG, and REVIEWDEFFLAG.

The term 'equivalent water' is referred to frequently in the description of the commands in this utility. An asterix (*) is used within the command description indicates an 'equivalent water' unit. This corresponds to the value that would have occurred if a water path was used for the stand-off material. A wave speed of 58400 inches/sec is assumed for water.

An 'equivalent water' standoff height should be the water path length that would give the same time-of-flight (time delay) as that which was actually used. For example:

> If a 0.2-inch high lucite wedge was used with a sound speed of 108000-inches/sec then the equivalent water standoff height is (0.2 / 108000.0 * 58400.0) = 0.108 inches.

The 'equivalent water' incident angle (squint_angle) is the angle that, with a water column, will produce the same angle in the material as the actual test. Snell's law is required to calculate this:

$$I_W = \sin^{-1} [V_W/V_1 * \sin(I_1)]$$

For example:

> If the true incident angle is 38-degrees, and a lucite wedge was used with a speed of 108000-inches/sec, then the equivalent water incident angle is

'return' without entering a character string. Otherwise enter the new line. The prompt for the second line will then be displayed and the user may enter a new line of text or enter 'return' for no change. The new resulting comment text will then be displayed.

syntax: COMMents
example: COMM

DATA

Modify specific data point in a-scan record previously selected with the GETRECORD command. The user must specify the 'Z' level or sample point in the A-scan record and may select a new value to be placed there. If no new value is specified, the current value will be displayed. Data values must range from 0 to 255.

syntax: DAta z_level [new_value]
example: DA 143
DA 345 127
AKA: VAlue

DEFECTFLAG

Define specific A-scan ranges that are predicted to be in the region of a defect (flaw). Regions specified are in the 'y' (circumferential) direction. All A-scan records in the 'x' (axial) direction that are included in the specified range will be flagged. This does not effect the SAFT processing, but is useful for performing advanced spectral analysis using statistical methods.

The 'y_min' and 'y_max' arguments define the lower and upper bounds of the desired region of interest. The 'i' option allows these values to be entered in inches; otherwise the units are sample points.

syntax: DEFectflag [I] y_min y_max
example: DEF 12 14
DEF I 1.23 2.56

DELAYINCREMENT

Modify the time interval that the samples were taken within each a-scan record. This value is in 10nsec units. So if 50nsec intervals (20MHz sampling rate) were utilized then enter 5 for the value.

syntax: DELayincrement [delay]
example: DEL 5

DECONVFLAG

Specify deconvolution flag. Non-zero value indicates that deconvolution has occurred on the data contained in this particular file.

syntax: DEConvflag [flag]
example: DEC 1

DIAMETER

Modify the value representing the effective diameter of the sound field at the entry point of the material. This value shapes the generated aperture so that the cone has a finite value at the surface of the material. Historically this has been 0.0, so that no off-center a-scans are summed at the top of the aperture cone. With pulse-echo configurations this has been satisfactory, since the near surface signals are lost anyway in the front surface reflection. With TSAFT-2, however, some diameter is necessary to cause the near surface reflectors to be weighed in proportion to reality. This value is in units of inches. If no value is selected then the current value is displayed.

syntax: DIAmeter [new_value]
example: DIA .2
AKA: BEAMENtry

DISPLAY

Display contents of specified a-scan record. If no A-scan is specified on the command line, the A-scan record selected by the previous GETRECORD command is redisplayed. This command does not retrieve data into the buffer for editing.

syntax: DIsplay [ascan_number]
or DIsplay [x_coor,y_coor]
example: DI 546
DI 25,30

ENVDETFLAG

Specify envelope detection flag. Non-zero value indicates that envelope detection has occurred on the data contained in this particular file.

syntax: ENVdetflag [flag]
example: ENV 1

FOCALLENGTH

Modify value of the transducer focal length located in the file header. This value must be in equivalent water units. Normally this value is set to equal the height of the transducer as specified in the HEIGHT command.

syntax: FOcallength [value]
example: FO 1.45

FREQUENCY

Modify transducer center frequency value in header. This value is in MHz units.

syntax: FREquency [freq]
example: FRE 2.25

GETRECORD

Select a specified A-scan record to be edited. This brings a particular a-scan into the editing buffer and also displays its contents.

syntax: Getrecord [ascan_number]
or Getrecord [x_coor,y_coor]
example: G 546
G 25,30

HEIGHT

Modify the value of the height of the transducer located in the file header. This value has units of inches and must be in equivalent water units. In pulse-echo mode only one parameter is required since there is only one transducer. In tandem mode transducer heights are entered as separate parameters.

Because this value is in equivalent water units, it is common practice to modify this parameter using an itterative method. Initially enter a reasonable value. Then use the DHEAD command to display the value(s) that correspond to the given configuration (i.e. standoff velocities, etc.). If the value(s) represented in the display from DHEAD are not precisely as desired, then repeat the process.

syntax for pulse-echo mode:
HEIght [ducer_height]
example for pulse-echo mode:
HEI 1.45
syntax for TSAFT/TSAFT-2 modes:
HEIght [xmit_ht , recv_ht]
example for TSAFT/TSAFT-2 modes:
HEI 1.45 1.45

INCIDENTANGLE

Modify the angle of incidence as specified in the file header. This value is in equivalent water units, and it is common practice to modify this parameter using an itterative method. Initially enter a reasonable value. Then use the DHEAD command to display the value(s) that correspond to the given configuration (i.e. standoff velocities, etc.). If the value(s) represented in the display from DHEAD are not precisely as desired, then repeat the process.

```
syntax:   INCIdentangle  [newangle]
example:  IA  19.4
AKA:      IAngle, SQUINTAngle, SAngle
```

INITIALDELAY

Modify the time delay before the first sample was taken in each A-scan record. This value is in 10nsec units. So if a 63usec delay occurred, then enter 6300 for the value.

```
syntax:   INitialdelay [delay]
example:  IN  6300
```

MODE

Specify the mode (configuration) that the data was collected. Currently there are three modes that are valid: PULSE-ECHO, TSAFT, and TSAFT-2. The specific mode may be specified simply by entering the desired mode.

```
syntax:   MODE  [new_mode]
examples: MODE  PULSE-ECHO
          MODE  PU
          MODE  PE
          MODE  TSAFT
          MODE  TANDEM
          MODE  TSAFT2
          MODE  TSAFT-2
          MODE  TANDEM-2
          MODE  TANDEM2
```

NODEFECTFLAG

Define specific A-scan ranges that are predicted NOT to be in the region of a defect (flaw). Regions specified are in the 'y' (circumferential) direction. All A-scan records in the 'x' (axial) direction that are included in the specified range will be flagged. This does not effect the SAFT processing, but is useful for performing advanced spectral analysis using statistical methods.

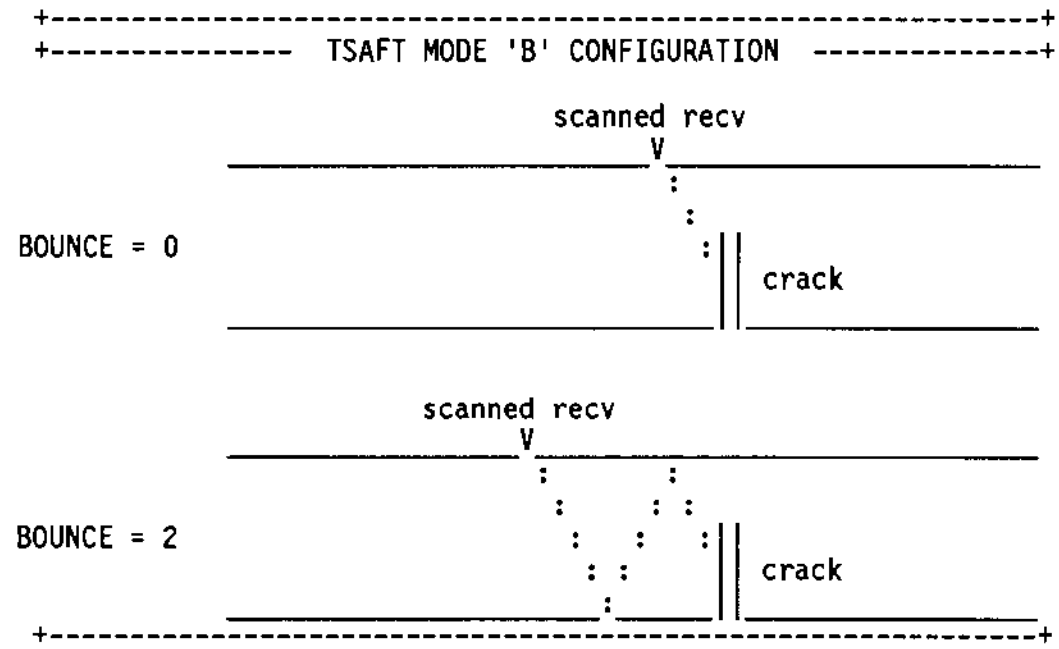
The 'y_min' and 'y_max' arguments define the lower and upper bounds of the desired region of interest. The 'i' option allows these values to be entered in inches; otherwise the units are sample points.

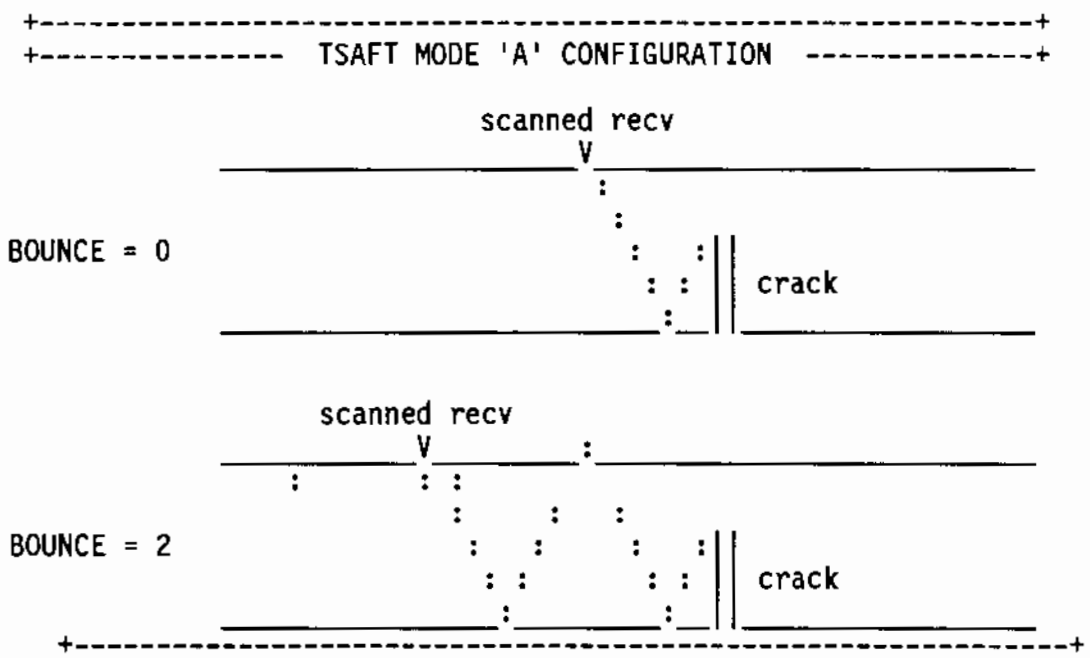
syntax: NODEFectflag [i] y_min y_max
example: NODEF 12 14
NODEF I 1.23 2.56

NRBOUNCE

Specify the number of receiver skip bounces present when collecting TSAFT/TSAFT-2 data. This number corresponds to the number of reflections that occur from the object region to the receiver probe. The diagrams following show examples for how this is determined.

syntax: NRBounce [num_bounces]
example: NRB 3
AKA: NRSkip

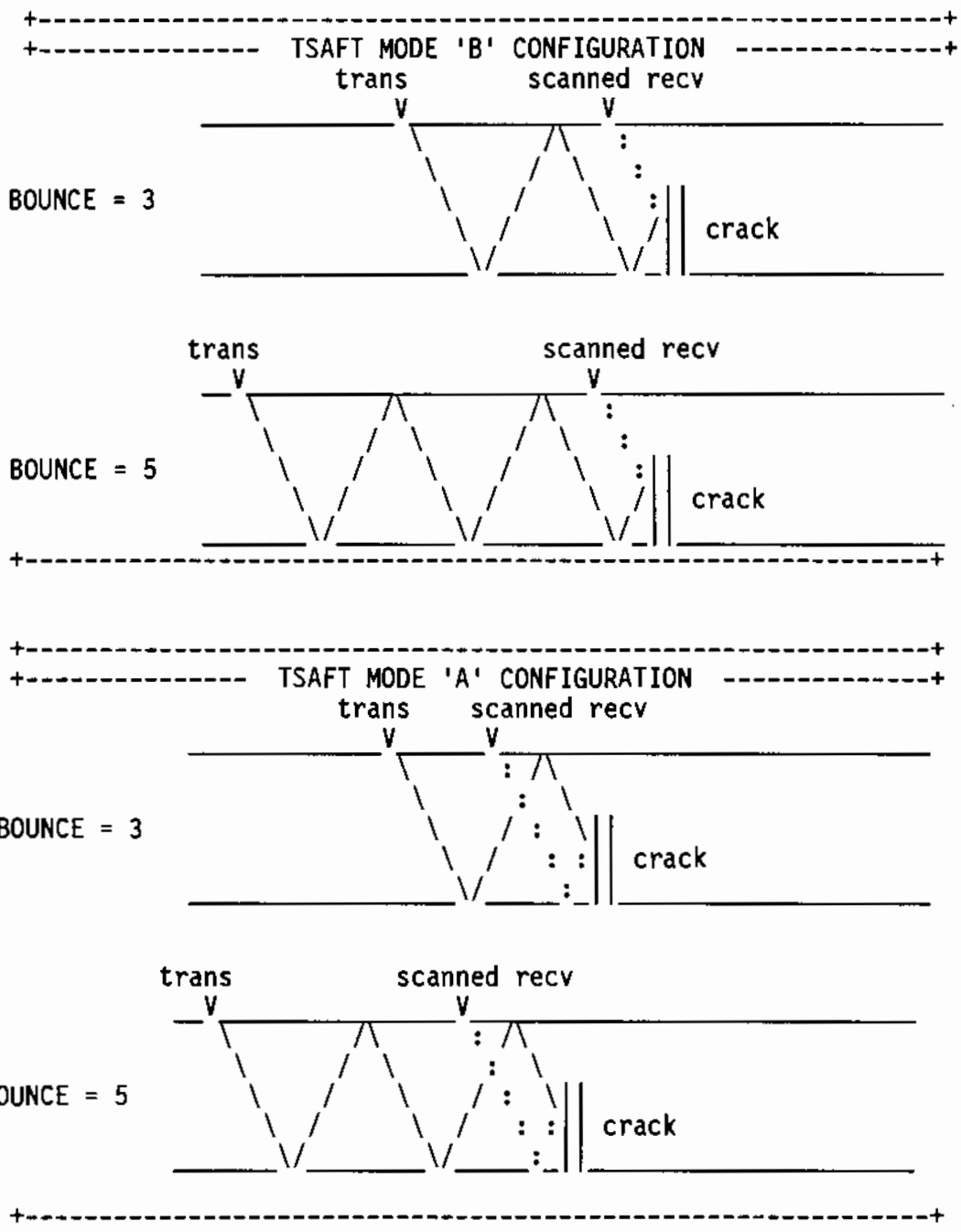




NTBOUNCE

Specify the number of transmit skip bounces present when collecting TSAFT/TSAFT-2 data. This number corresponds to the number of reflections the center ray encounters prior to entering the object region. The diagrams following show examples for how this is determined.

syntax: NTBounce [num_bounces]
example: NTB 3
AKA: NTSkip


TSAFT MODE 'B' CONFIGURATION
trans
scanned recv
BOUNCE = 3
crack
trans
scanned recv
BOUNCE = 5
crack
TSAFT MODE 'A' CONFIGURATION
trans
scanned recv
BOUNCE = 3
crack
trans
scanned recv
BOUNCE = 5
crack

NUMA

Modify the number of a-scan value in header of file.

syntax: NUMA [newvalue]
example: NUMA 350
AKA: NA

NUMX

Modify the number of x-axis points in header of file.

syntax: NUMX [newvalue]
example: NUMX 30
AKA: NX

NUMY

Modify the number of y-axis points in header of file.

syntax: NUMY [newvalue]
example: NUMY 60
AKA: NY

PHI

Modify the PHI angle of the current A-scan record header. A record must have been previously specified using the GETRECORD command. If no value is specified, phi of the current record is displayed.

syntax: PHi [value]
example: PH 90

PIPEFLAG

Specify pipe scan flag. Non-zero value indicates that scanning for this file occurred on pipe.

syntax: PIPEFlag [flag]
example: PIPEF 1
AKA: PFlag

PIPERADIUS

Specify radius of surface that was scanned to produce this data file. This value is in inch units. An entry of zero indicates that the surface was flat or that this is an insignificant attribute.

syntax: PIPERadius [rad_of_curvature]
example: RAD 13.76
AKA: RADius

PROCMODE

Specify process mode detection flag. A selection of "exact" or "table" is required. This indicates that the "exact" or "table" algorithm was used to calculate this data file. This flag was used in the UofM PLOTGEN utility and is not used otherwise.

syntax: PROCMode [exact/table]
example: PROCM TABLE

PROCFLAG

Specify SAFT processing flag. Non-zero value indicates that SAFT processing has occurred on the data contained in this particular file.

syntax: PROCFlag [flag]
example: PROCF 1

REVIEWDEFFLAG

This command displays defect regions that have been specified previously by either the DEF or NODEF command.

syntax: REVIEWDefflag
example: REVIEWD

RSTOFFVEL

Modify the acoustic velocity of the receiver's standoff. Units for this parameter are in inches per second.

syntax: RSToffvel [wave_speed]
example: RST 58400

SMDEPTH

Specify the depth to be used for software machining (a surface deviation correction technique). Units are 0.001 inches.

syntax: SMDepth [depth]
example: SMD 50

STATS

Explicitly specify data file minimum, maximum and average. This is normally performed by executing the CSTAT utility on the given SAFT data file. This command, therefore, is not normally used, and SHOULD BE USED ONLY WITH CAUTION.

syntax: STATS [min max avg]
example: STATS 0 255 127.5

SUMATIONS

Specify the number of summations that occurred if multiple a-scans were collected and averaged at a given location. This technique has been used to reduce the contribution of random noise in the system.

syntax: SUmations [num_ascans_averaged]
example: SU 5

THETA

Modify the THETA angle of the current A-scan record header. A record must have been previously specified using the GETRECORD command. If no value is specified, theta of the current record is displayed.

syntax: THEta [value]
example: THETA 25

THICKNESS

Modify the material thickness value located in the file header. This value has units of inches.

syntax: THIckness [mat_thickness]
example: THICK 5.46

TSTOFFVEL

Modify the acoustic velocity of the transmitter's standoff. Units for this parameter are in inches per second.

syntax: TSToffvel [wave_speed]
example: TST 58400

VELOCITY

Modify the value of the specimen material velocity located in the file header. This value is in INCHES/SEC units.

syntax: VElocity [value]
example: VE 58400

WINDOWSTART

Beginning depth in the material where data sampling began. This can be thought of as the start of the sampling 'gate'. This is the distance (in inches) from the front surface of the material to the start of the data sampling window. The distance is measured along the center-ray sound path, so if the incident angle is non-zero one must follow the angle in the material to get this distance.

syntax: WINDOWSTArt [distance]
example: WINDOWSTA 0.56
AKA: WSTart, ZStart

WINDOWSTOP

Ending depth in the material of data sampling window. This can be thought of as the end of the sampling 'gate'. This is the distance (in inches) from the front surface of the material to the end of the data sampling window. The distance is measured along the center-ray sound path, so if the incident angle is non-zero one must follow the angle in the material to get this distance.

syntax: WINDOWSTOp [distance]
example: WINDOWSTO 2.5
AKA: WSTOp, WEND, ZEnd

WRITE

Write the edited data to file previously specified by the FILE command.

syntax: Write
example: WRITE
AKA: Build, PUtf, PUtrecord

XINC

Modify the x-axis increment value in the file header. This value is in units of 0.001 inches. In other words to specify an increment of 1.0 inch enter 1000.

syntax: XInc [newvalue]
example: XINC 1000

XOFFSET

Modify the initial transducer separation in tandem mode. This value has units of inches. This value is critical in TSAFT/TSAFT-2 processing.

syntax: XOFfset [ducer_separation]
example: XOFF 0.45

XSTART

Modify the starting position of the axial axis (X-axis) with respect to an external mark such as a scribe line or the weld center line. The sign of this value is relative to this mark. If the scanner collects the data as it scans toward the reference mark, then it is a negative value. In most cases this value is negative. This variable has units of 0.001 inches, so if a specification of 1.0 inch is desired enter 1000. If no new value is specified the current value is displayed.

syntax: XStart [new_value]
example: XS-1250
AKA: XPos, WCL, INITX, RCVX

YEND

Modify the ending position of the circumferential axis (Y-axis) with respect to an external mark such as a scribe line. This variable has units of inches. If no new value is specified the current value is displayed.

syntax: YEnd [new_value]
example: YE 17.5

YINC

Modify the y-axis increment value in the file header. This value is in units of 0.001 inches. In other words to specify an increment of 1.0 inch enter 1000.

syntax: YInc [newvalue]
example: YINC 1000

YSTART

Modify the starting position of the circumferential axis (Y-axis) with respect to an external mark such as a scribe line. This variable has units of inches. If no new value is specified the current value is displayed.

syntax: YStart [new_value]
example: YS 17.5
AKA: YPos

ZPOSITION

Modify the z-position of the current a-scan record header. A record must have been previously specified using the GETRECORD command. The z-position value is in 0.001 inch units so that 1.0 inches is entered as 1000. If no value is specified, the z-position of the current record is displayed.

syntax: Zposition [value]
example: Z 533

7.4 GENAPT

GENAPT Conventions and Overview:

This SAFT utility is intended to provide a mechanism for generating alternate aperture definition files. These files are used during SAFT processing and contain the definition of the aperture cone shape. Normally the aperture definition is generated automatically during processing using the information in the data file header to shape the cone. The user, however, may use this utility to produce line-SAFT processing. This is done simply by adjusting the aperture definition file using the LINESAFT command. Alternate cone shapes may also be specified by using the TROUGH and DOUGHNUT commands. These effectively perform high-pass spatial filtering. See Section 3.2 of the GUIDE TO SAFT-UT PRINCIPLES AND CONVENTIONS for further information regarding aperture definition.

After an aperture file is created, one may view the contents by using the DUMPAPT utility as described previously in Section 4.6 of this document.

VMS syntax:

```
$ GENAPT  [data_file_name]
```

BEAMANGLE

Specify the desired full angle of the aperture cone in the specimen material. This is specified for an on-axis cone. That is if the transducer has a non-zero incident angle in the X direction, then this angle is the beam angle measured along the Y axis. Units are degrees.

```
syntax:   BEAMA  angle
example:  BEAMA  12.5
AKA:      BAngle
```

CLIP

Specify a maximum radius (in inches) that the aperture cone will be limited to. The default value is 3 inches.

```
syntax:   CLIP  radius_in_inches
example:  CL    1.5
AKA:      RADius
```

DOUGHNUT

This command effects the shape of the conical aperture being generated. It specifies that the center of the cone will not be included in the final aperture. A cylindrical shape will be excluded from the center of the cone. This cylinder has the diameter of the 'entry point beam width

diameter' parameter in the header. (This diameter may be modified in the DEDIT utility). This option is useful when only high spatial frequencies are of interest.

This command is an action command (like BUILD). It creates a specified aperture definition output file.

syntax: DOUGhnut aperture_filename
example: DOUG TEST.APF

FULLSAFT

Specify that a full 3-dimensional SAFT aperture will be formed. THIS IS THE DEFAULT.

syntax: FULL
example: FULL
AKA: 3Dimensional

INAPERTURE

Specify aperture file, that was previously made by this utility, to be retrieved from disk to be used to form a new aperture definition file. This file will be used to generate appropriate parameters instead of using a data file for the input.

syntax: INA input_aperture_file_name
example: INA aperture.fil
AKA: READAperture, GETAperturefile

INCIDENTANGLE

Specify the receive transducer incident angle (degrees). This value must be entered in equivalent water path units. See the DEDIT utility description (Section 7.3) for further information regarding equivalent water path units.

syntax: INCI angle
example: INCI 9.45
AKA: IAngle, SQUintangle, SQAngle

LASTDEPTH

Specify the depth, along the center ray sound path, at which processing is desired to end. NOTE: for pulse-echo applications, this value MUST be greater than the header parameter "window_end" in the data file to be processed. For tandem files, this will be forced to twice the path length necessary to reach the far surface.

syntax: LAstdepth depth_along_sound_path
example: LA 3.45
AKA: ENDDepth

LINESAFT

Specify a line-SAFT aperture that will focus the data only along the axis indicated on the command line. Line-SAFT processing in the direction of the tilt of the transducer is most common.

syntax: LInesaft x | y
example: LINE X
AKA: 2Dimensional

PARAMETERS

Display current aperture file specification.

syntax: PArameters
example: PA

STARTDEPTH

Specify the depth, along the center ray sound path, at which processing is desired to begin. NOTE: For pulse-echo data files this value must be equal to the "window_start" value in the header of the file to be processed. This value will be set to 0.0 for tandem data files.

syntax: STartdepth depth_along_sound_path
example: ST 3.45
AKA: BEgindepth

TROUGH

This command effects the shape of the conical aperture being generated. It specifies that the center of the cone, along the x axis, will not be included in the final aperture. One way of looking at this is that Ascans with small Y values will not be included in the conical aperture shape. Its as if a shovel were dragged along the X axis to scoop out the cone. The width of the "trough" generated is the 'entry point beam width diameter' parameter in the header. (This diameter may be modified in the DEDIT utility). This option is useful when only high spatial frequencies, in Y, are of interest.

This command is an action command (like BUILD). It creates a specified aperture definition output file.

syntax: TROugh aperture_filename
example: TRO TEST.APF

WRITE

Make specified aperture file based on current parameters.

syntax: BUild filename
example: BU aperture.fil
AKA: BUild, MAkefile

7.5 SAFTPROC

SAFTPROC Conventions and Overview:

This SAFT utility is the program that is normally implemented to perform SAFT processing. It provides a command driven tool for performing this function. System defaults are initially established for processing parameters, and may be altered easily by selecting the appropriate command. The 'GO' command invokes a child process that will perform SAFT processing as specified by the selected parameters.

> ******* WARNING *******
>
> Unpredictable results may occur if independent processes spawn SAFT processing while residing in the same directory. That is, if the default directory for both users is identical. The reason for this is this utility automatically generates temporary communication files and the SAFT processing module that is spawned deletes them when it is complete. These files have fixed names so if another job creates one in the same directory, then it is uncertain which will be read and deleted. Also, the aperture definition file (if automatically generated) has the same problem.
>
> The way to avoid this problem is simply to select unique default directories when running this utility coincidentally with another user or batch job. Data files to be operated on or generated may reside in the same directory with no difficulty.

VMS syntax:

```
$ SAFT  [data_file_name]
```

APERTURE

Specify an existing aperture file to be used by the processing module. If this is not specified, a temporary aperture definition file will be generated from the data header information. This file ("APERTURE.FIL") is deleted when the processing completes.

```
syntax:   APERture  filename
example:  APER  SYNTHAPER.FIL
AKA:      APFile, GETAperture
```

AUTORED

Specify that data sampling reduction will occur automatically. Automatic data sampling reduction will alter only the Z-axis envelope detection factor as described in the text relative to the "REDUCTION" command. This factor determines the sampling reduction that will occur along the Z-axis (in the temporal direction) after the envelope detection process. The factor to be used is determined automatically by selecting that which will produce a z-axis spatial sampling that is approximately twice that of the x-axis. This means that the graphics pixel dimensions will be more cubic than was the previous case in the r-f data file. The Z-axis pixel dimension will then be on the order of the lateral axes' pixel length. AUTOMATIC DATA SAMPLING REDUCTION IS THE DEFAULT.

syntax: AUTORed
example: AUTOR

BEYOND

Specify whether processing will proceed beyond the specified thickness of the material. In pulse-echo mode this has meaning only if sampling occurred beyond when the far surface echo would occur and if the thickness value in the file header is non-zero. In tandem modes, if "NO" or "OFF" is selected for this command, the processing file will include image data from the front surface to the far surface. If "YES" or "ON" is selected then processing will occur from the front surface to twice the material thickness specified in the header. Default for this parameter is "YES" for tandem files and "YES" for pulse-echo files.

syntax: BEYond ["NO" | "YES"]
or BEYond ["OFF" | "ON"]
example: BEY OFF

CLIPACTION

Specify processing action when, during processing, the amplitude of a given data point is less that the selective processing threshold. Also determine how the data value is to be normalized. An ODD entry specifies that the raw data value will be used on a skip event. An EVEN entry specifies that zero will be placed as the resultant value on a skip rather than processing a full aperture at that point.

Entry of '1' or '2' specifies averaging the summed value to determine the result. This is sometimes referred to as weighting by a squared factor. (SPECULAR REFLECTORS)

Entry of '3' or '4' specifies that no normalization will occur whatsoever. A constant scaling factor will be used to reduce the possibility of saturating the output data file. But no weighting is implemented in this selection.

Entry of '5' or '6' specifies that a linear weighting is used. (DIFFUSE REFLECTORS)

The default value is "1" for pulse-echo files and "2" for tandem files.

syntax: CLIPAction [value]
example: CLIPA 1
AKA: NORMaction

CPLOT

Invoke a subprocess that executes the CPLOT utility. The input file to the CPLOT utility is the file defined as the output file in the SAFTPROC utility. This allows the operator to view the processing results as they are being calculated. The user may invoke processing using the GO command without the 'wait' qualifier; and then pre-view the results with the CPLOT command. If the file does not exist this command will exit immediately. So wait until the processing module has created the output file before actually invoking CPLOT.

syntax: CPLOt
example: CPLOT

ENVDETECTION

Specify whether envelope detection is to be implemented in the SAFT processing module. This is referring to envelope detection subsequent to SAFT processing. The SAFT processing will not be effected. Default is "ON".

syntax: ENVDetection ["ON" | "OFF"]
example: ENVD ON
AKA: DETection

GO

Invoke the SAFT processing module and initiate processing. This command will "spawn" the appropriate processing module. To abort all active processes enter the CNTL/C character. Multiple child processes may be invoked. To suppress this capability enter the 'Wait' parameter and the program will wait until all child processes have completed before returning to the <SAFT> prompt. Otherwise immediately following completion of the spawning process, the program will respond with a <SAFT> prompt and further commands may be entered. The user may also specify an executable to be

spawned other the default programs supplied in the SAFT Utilities package. This should not be used except by the most proficient users, or under special circumstances.

syntax: GO [saftprog.exe] [Wait]
example: SAFT W
AKA: SAFTproc, PROCess, DOit

HOSTPROC

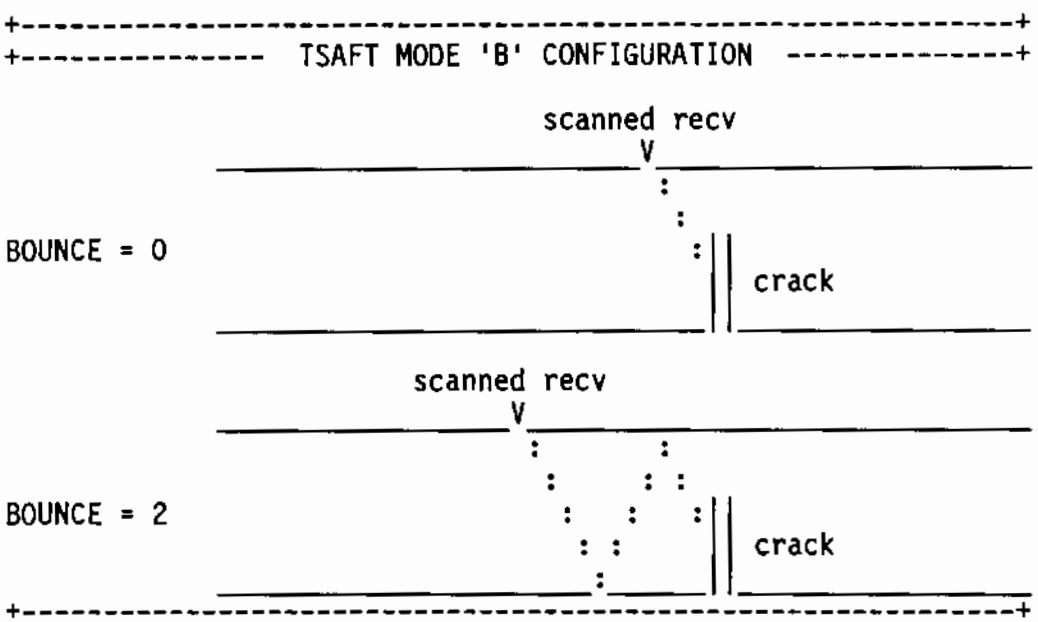
Specify that the SAFT processing module to be invoked is to perform all operations on the host computer and not utilize the REAL-TIME SAFT PROCESSOR peripheral device. HOST processing is assumed by default.

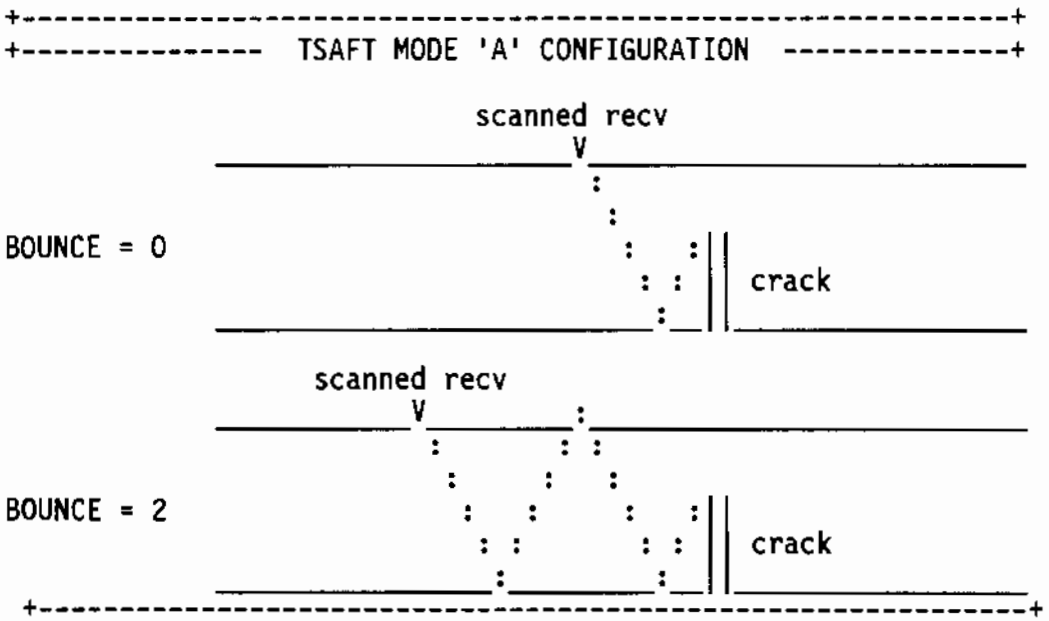
syntax: HOSTproc
example: HOST
AKA: VAXProc

NRBOUNCE

Specify the number of receiver skip bounces that were implemented when collecting TANDEM data. This number corresponds to the number of surfaces the center ray encounters before entering the object region. The diagrams following show examples for how this is determined.

syntax: NRBounce [num_bounces]
example: NRB 0
AKA: NRSkip

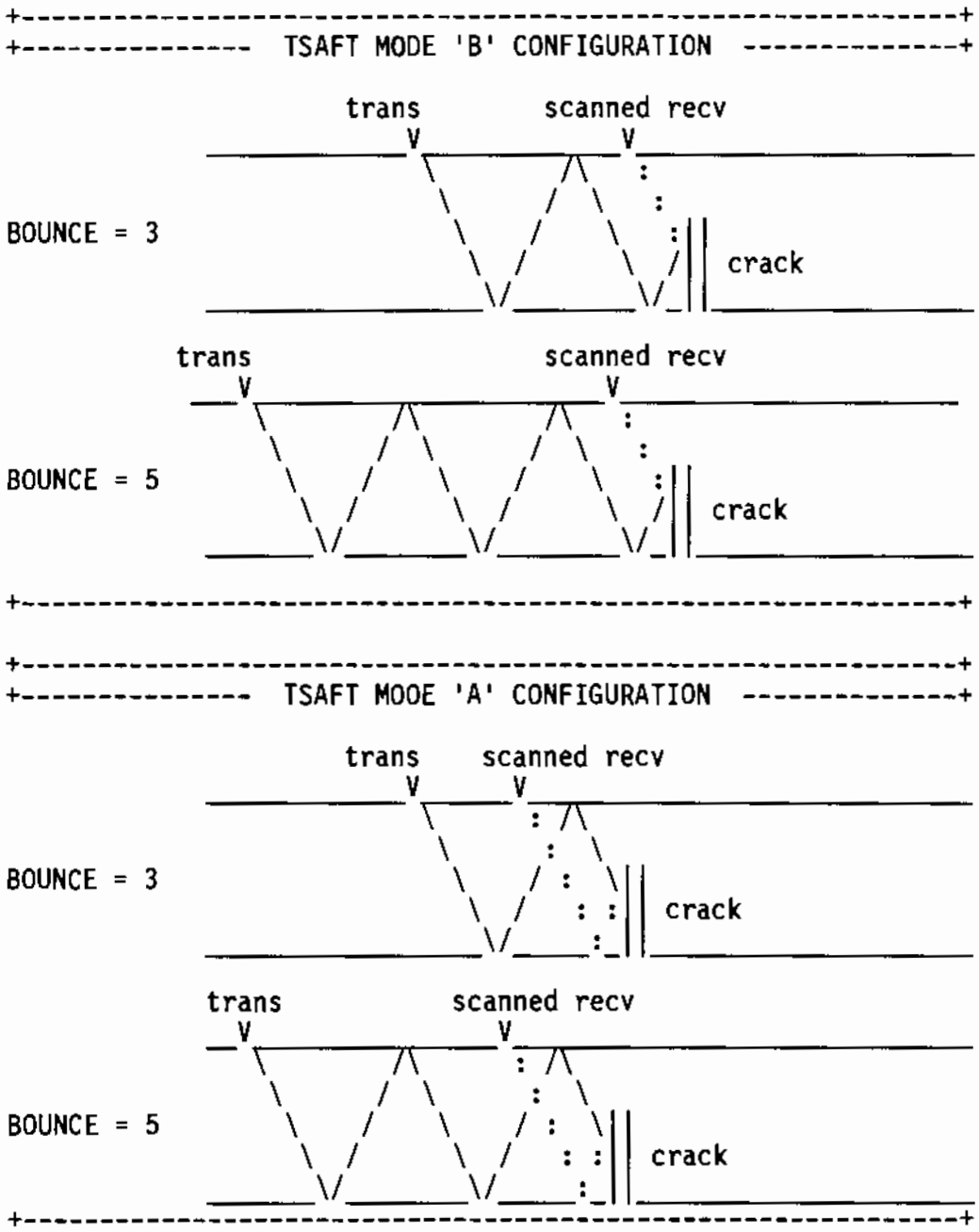




NTBOUNCE

Specify the number of transmit skip bounces that were implemented when collecting TANDEM data. This number corresponds to the number of surfaces the center ray encounters before entering the object region. The diagrams following show examples for how this is determined.

syntax: NTBounce [num_bounces]
example: NTB 3
AKA: NTSkip


TSAFT MODE 'B' CONFIGURATION
trans
scanned recv
BOUNCE = 3
crack
trans
scanned recv
BOUNCE = 5
crack
TSAFT MOOE 'A' CONFIGURATION
trans
scanned recv
BOUNCE = 3
crack
trans
scanned recv
BOUNCE = 5
crack

NORED

Specifies that there is to be no data sampling alteration in forming the output file. This is particularly important to select if no envelope detection is to be performed. The r-f phase information in the output file will not be retained if sufficient sampling is not also retained.

syntax: NORED
example: NORED
AKA: NOAUTored

OUTPUT

Specify a output file name to be generated by the SAFT processing module. If this is not specified, a filename is assumed that has the same prefix as the data filename, but has a suffix of ".ENV".

syntax: OUTput filename
example: OUT TESTFILE.ENV
AKA: ENVFile, FIOutput

PARAMETERS

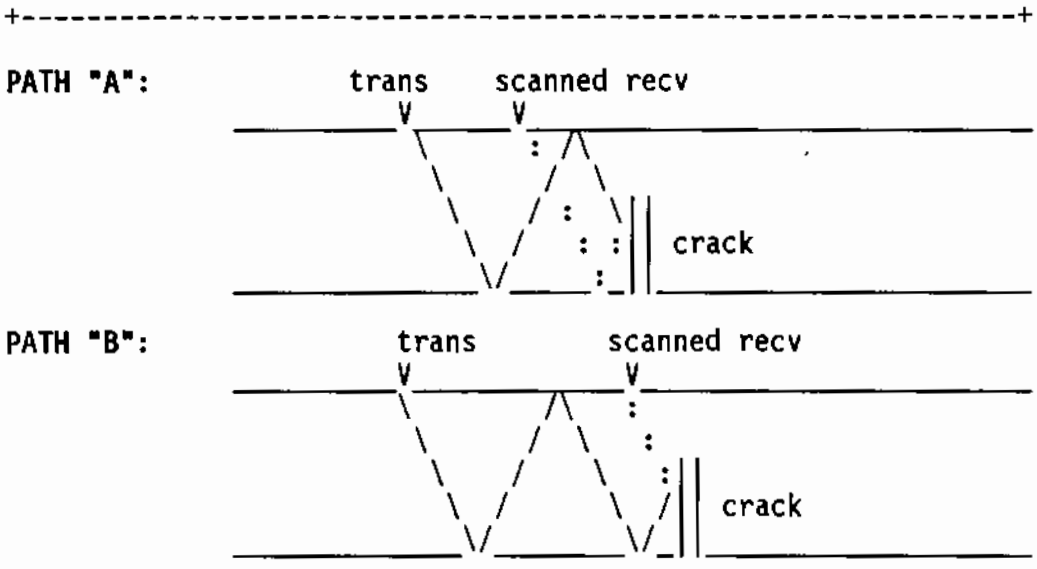
Display parameters to be used for processing.

syntax: PARameters
example: PAR

PATH

Specify bounce path that corresponds to the scan configuration. This has meaning only in TANDEM files. The default is path B. Diagrams showing the available choices are shown after this command description. Multiple paths may be chosen only for HOST processing. **NOTE:** Path B is the only case that has been thoroughly checked out with respect to software performance.

syntax: PATH ["A" | "B" | "C" | "D"]
example: PATH B



PATH "C": both xmit & recv are direct paths to the crack.

PATH "D": both xmit & recv paths bounce off the back surface before entering the object region.

REALTIME

Specify that the SAFT processing module to be invoked is to utilize the REAL-TIME SAFT PROCESSOR peripheral device. The default is HOST processing.

syntax: REALtime
example: REAL
AKA: SAFTBox, RTsp

REDUCTION

This command specifies explicitly the sampling alteration, if any, to be performed during processing. There are 4 possible factors that may be specified to reduce sampling for the purpose of expediting the processing or simply to reduce the size of the output, envelope detected, file.

The first two parameters effect the lateral sampling that occurs during the processing operation. The first one is the X (axial) and the second corresponds to the Y (circumferential) directions. If a value of 2 is selected for these parameters then every other a-scan will be processed; in other words, the entry value is a sampling divider. If both X and Y values are 2 then the output file size will be reduced by 4. Each point that is processed, however, uses the full data-set to compute the SAFT result. So the values that are computed are exactly the same values that would have been computed if no reduction were selected. Therefore, as in the above example, if 2 were selected for both the X and Y sampling reduction factors, approximately 4 times fewer computations would also result. A selection of 1 indicates that no sampling reduction will be done.

The third parameter effects the sampling reduction that occurs in the temporal direction (along the a-scan or Z axis). This is referred to as the Z-axis processing reduction factor. A non-unity factor will direct the processing to sample the processing operation by that factor. Again, if a value of 2 were selected for this parameter, the processing module would skip every other point along the a-scan while processing. Each point processed would utilize the complete data-set as before. An output file size reduction of 2 would be realized and about half as many SAFT calculations would be performed.

The fourth parameter does not effect the processing operation. This factor determines the sampling reduction to occur along the Z-axis (in the temporal direction) after the envelope detection process. Of course this only makes sense if envelope detection has been selected. The envelope detected signal has in general a much lower frequency content than the rf data; so that sampling may be reduced at this point without any loss of information. This technique simply compresses the number of points specified into one output point (the largest value in the window is retained for the output value). So a selection of 2 for this parameter will reduce the output file size by 2, but will not reduce the number of SAFT calculations at all. Default for sampling reduction is the "automatic" form, as described in the text for the "AUTORED" command.

```
syntax:   REDuction  [ x,y,z_proc,z_envelope ]
example:  RED  1 1 1 5
          RED  1 1 1 1
AKA:      MANualred
```

SELECTIVE

Specify the selective processing threshold level that will be implemented in the SAFT processing module. This is entered in DB units relative to the maximum value in the data file. So an entry of -20 will specify a value 10% of the maximum. If selective processing is not desired, an entry of -45 or less effectively disables this option. The default value is -20db.

syntax: SELective [clipping_threshold_in_db]
example: SEL -20
SEL -60
AKA: CLIPping, THREShold

7.6 TPLOT

TPLOT Conventions and Overview:

This SAFT graphics utility provides a mechanism for displaying SAFT images on a local Tektronix 4105 terminal or equivalent. The B-scan end-view and B-scan side-view are currently the two projects supported by this utility. After each selected command, a PLOT command is necessary to realize the option on the display.

This utility assumes the following color scale has been set on the terminal:

index 0	index 1	index 2	index 3
0,0,0	0,50,100	320,40,100	240,50,100
index 4	**index 5**	**index 6**	**index 7**
180,50,100	160,50,100	120,50,100	60,50,100

During run time, the dialog is set to:

characters = index 1
background = index 0

VMS syntax:

$ TPLOT [data_file_name]

ASCAN

Plot single ascan on graphics device. If the optional parameter -O is selected the screen will not be cleared (overlay mode) before plotting.

syntax: Aplot [-O] ascan_number
example: A 45
ASCAN -O 78

CURSOR

Enter "cursor" mode for sizing. After cursor mode has been invoked, the following commands become valid:

'1' set point 1 coordinates.
'2' report difference between point 1 values and the current cursor location.
'Q' exit cursor mode.

syntax: CURsor
example: CUR

DCLEAR
Clear the dialog (text) area. This command is particularly useful after issuing the 'HELP -O' or the 'DHEAD -O' commands.

syntax: DClear
example: DC
AKA: DErase, DIAclear

ERASE
Erase the screen.

syntax: ERase
example: ER
AKA: CLear

NORMAL
Normalize data by specified data range. This command requires that the user replot the image after specifying the new normalization.

syntax: NOrmal min max
example: NO 0 127

PARAMETERS
Display file parameters.

syntax: PArameters
example: PA

PLANE
Select the plane to be displayed with the subsequent PLOT command. The xz or yz planes may be selected.

syntax: PLane [XZ | YZ]
example: PL YZ
AKA: RESEt

PLOT
Put current file to screen. If the optional parameter -O is selected the screen will not be cleared (overlay mode) before plotting.

syntax: PLOt [-O]
example: PLO
AKA: Build, Go, PUtf, Write

UNNORMALIZE

Negates the 'NORMAL' command. This command sets the data range equal to the default values, where min & max are the min & max values of the data file.

```
syntax:   UNNormalize
example:  UNN
```

X

Specify subset of X planes to be plotted. If the 'i' option is specified then the planes are to be given in units of inches.

```
syntax:   X  [I]  start_plane  end_plane
example:  X 0 23
          X i 0.0 2.3
```

Y

Specify subset of Y planes to be plotted. If the 'i' option is specified then the planes are to be given in units of inches.

```
syntax:   Y  [I]  start_plane  end_plane
example:  Y 40 80
          Y i 4.0 8.0
```

8.0 OPERATION OF SAFT-UT REAL-TIME PROCESSOR

The appropriate program must be executed on the Real-Time Processor before SAFT processing can be initiated on the host VAX computer. This is accomplished by choosing the CP/M User area that corresponds to the configuration desired. Usually the application programs have been installed such that the pulse-echo configuration program resides in User 1, and the TSAFT / TSAFT-2 program resides in User 10.

After the correct User has been selected with the CP/M 'USER' command, enter the command 'STARTUP' from the Processor's terminal. This procedure will initialize the slave processors, then subsequently it will execute the supervisor program. The user, at this time, may be prompted for particular configuration parameters. The following is a list of these prompts and the correct responses:

```
# OF SLAVE PROCESSES?    <enter the number of installed slave cards>
# OF PHYSICAL SLAVES?    <enter the number of installed slave cards>
LOW_SYNC AND HIGH_SYNC?  0 0
```

Some installations will not include these prompts. The final message, after successful execution of the supervisor program, will include:

```
WAITING FOR VAX TO SYNC
```

The SAFT Processor is now waiting for the host VAX to initiate SAFT processing (the utilities RTFSAP, RTFTSAP, or SAFTPROC may be used for this purpose). Selection of the RT command in the SAFTPROC utility on the host VAX will specify the use of the Real-Time Processor for SAFT processing. The following GO command will spawn the appropriate sub-processes to perform the SAFT computations.

To switch from one configuration to another, the user must press 'reset' on the SAFT Processor module, reselect the appropriate User, and re-enter the startup sequence.

PNL-6276
UC-32

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