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xdamp Version 4.123: An IDL®-based Data and Image Manipulation Program

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xdamp Version 4: An IDL®-based Data and Image Manipulation Program

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Abstract

The original DAMP (DAta Manipulation Program) was written by Mark Hedemann of Sandia National Laboratories and used the CA-DISSPLA™ (available from Computer Associates International, Inc., Garden City, NY) graphics package as its engine. It was used to plot, modify, and otherwise manipulate the one-dimensional data waveforms (data vs. time) from a wide variety of accelerators. With the waning of CA-DISSPLA and the increasing popularity of Unix®-based workstations, a replacement was needed. This package uses the IDL® software, available from Research Systems Incorporated, a Xerox company, in Boulder, Colorado, as the engine, and creates a set of widgets to manipulate the data in a manner similar to the original DAMP and earlier versions of *xdamp*. IDL is currently supported on a wide variety of Unix platforms such as IBM® workstations, Hewlett Packard workstations, SUN® workstations, Microsoft® Windows™ computers, Macintosh® computers and Digital Equipment Corporation VMS® and Alpha® systems. Thus, *xdamp* is portable across many platforms. We have verified operation, albeit with some minor IDL bugs, on personal computers using Windows 95 and Windows NT; IBM Unix platforms; DEC Alpha and VMS systems; HP 9000/700 series workstations; and Macintosh computers, both regular and PowerPC™ versions. Version 4 is an update that removes some obsolete features and better supports very large arrays and Excel formatted data import.

Acknowledgements

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Introduction

xdamp is licensed software. To obtain a license, contact William P. Ballard at wpballa@sandia.gov. If you are licensed, you will receive automatic notification of updates.

PHILOSOPHY

xdamp relies, in as many places as possible, on IDL maintained routines. This choice should allow *xdamp* to age gracefully as Research Systems, Inc. will do most of the updating of the operations that actually modify the internal data. Nearly all of the procedures are precompiled when *xdamp* is started because the IDL macro programming language is interpreted at run time. Precompiling causes *xdamp* to pause initially while nearly everything is compiled, but results in faster execution times when manipulating data. The runtime licensed version of *xdamp* starts more quickly, but some flexibility in user customizing is lost as a result.

xdamp loads all the data into a set of working waveform arrays and image matrices and then closes the data file. It creates a button for each waveform/image and all manipulations can be done by pushing waveform/image buttons, followed by operator buttons. Two stacks are maintained, one for images and one for waveforms. Thus, you can switch modes easily and change back to the same state after manipulating data in the other mode without losing the waveform or image selections. You can choose whether the stacks are maintained between operations or are automatically cleared.

The original contents of the file are unchanged until you actively overwrite the original file. When attempting to overwrite a file, you are asked if you are sure you want to do this. However, *xdamp* minimizes how often it asks for confirmation of actions.

xdamp saves data using the Hierarchical Data Format (HDF) developed by the National Center for Supercomputing Applications (NCSA). IDL provides all the requisite HDF file handling utilities for all of the computing platforms of interest. Full libraries of FORTRAN and C routines are available from NCSA at http://hdf.ncsa.uiuc.edu/. The contents of the graphics area may be written to a file in a number of standard graphics formats such as EPS, JPEG, GIF, TIFF, and PICT. Waveforms and images may also be written out in an ASCII format for interchange with other software packages. However, these ASCII files are very large compared to the HDF files.

Whenever an operation is performed, the results are immediately and automatically plotted out (if the automatic plot feature is on). Also, the relevant pulse parameters (maximum, minimum, mean, standard deviation, pulse width, rise time, and fall time) are calculated. When plotting images, only the image on the top of the stack is plotted.

xdamp is designed to be self documenting. There are areas in the data file for notes relating to the overall data set and notes for each individual waveform/image. *xdamp* keeps an audit trail of the operations performed on each waveform/image that change its contents. The audit trail and the individual notes are displayed whenever a single waveform or image is graphed.

Automatic execution of command (macro) files is supported. This feature allows the user to create new procedures from combinations of existing operations. These files can

be nested up to 10 deep to create complicated operations from a sequence of simple macros.

xdamp automatically creates a journal file named **xdamp.jnl** in the base xdamp directory. The journal file can be copied and edited to easily create a macro file. Whenever a "summary" operation is performed, a spreadsheet file called **xdamp.csv** is created. This contains comma delimited information with the name, the maximum and minimum values, the rise and fall times, as well as the full-width-at-half-maximum pulse widths for all selected waveforms or all waveforms if none are selected. Also, the contents of registers 0-9 are output in the spreadsheet.

There is a powerful and flexible initialization file called **xdamp.ini** that can be used to customize each session according to the desires of the particular user. The maximum size and number of waveforms and images can be specified in this file.

When performing any operation with an inherent order, the ENTER button must be used to select one of the waveforms or images. Usually this defines the waveform/image to be overwritten; for instance, when performing a addition of two waveforms In some instances the ENTER button is used to define the reference waveform (COMPARE, aligning waveforms, and when generating cable compensators). In the case of inverse fast Fourier transforms (IFFTs), the ENTER button is used to designate the real portion of the waveform to be transformed.

The limits on the number of possible waveforms/images and their maximum sizes are relatively arbitrary. These limits can be seen by using the TOOLS.SHOW LIMITS menu selection. The system manager can increase the defaults at will (in the **XIsys_ini.pro** module in the **XIsys_sp.pro** file) but the user has independent control through his individual **xdamp.ini** initialization file. Extremely long waveforms are possible but may create difficulties on computers with limited memory. We recommend that you keep the maximum number and maximum length of both waveforms and images close to what your problem actually requires. *xdamp* automatically allocates the required internal working data space so you do not need to consider this when sizing the number of arrays or images.

Some of the operators create new waveforms or images, if space permits. If space does not permit, the original waveform/image is *overwritten* unless more than one waveform/image is generated, in which case the operation fails with an error message. To conserve waveform/image space, if an operation that creates new waveforms is repeated, and would duplicate some waveform/image names, the old waveforms are automatically overwritten.

FULL LICENSE INSTALLATION

The *xdamp* source code is provided in a tar file named xdamp4XXX.tar, a zip file xdamp4XXX.zip, or an executable zip file xdamp4XXX.exe where XXX refers to the version in all cases. It should be installed in the directory $IDL_PATH/lib/xdamp using the command "tar -xvf xdamp4XXX.tar", an appropriate UNZIP utility, or the self executing unzip. *xdamp* is designed to be loaded in a new xdamp directory under the RSI distribution library folder. Be certain the directory has public read permission and that all files in the directory also have this permission. Almost all system-specific information is contained in the file **XIsys_sp.pro**. The system manager must edit the **XIsys_ini.pro** module in this file and set the default print queue name. However, VMS

systems use the xdamp$PRINTER logical for this and don't need editing, just definition of the logical. The default limits for the number of waveforms (maxarrays), their maximum length (maxsize), the number of images (maximages), their maximum size (nxmax, nymax), and the default graphics area (xgsize, ygsize) can be changed in the XIsys_ini module in this file also. Finally, some customizing of the waveform/image button area is possible in this file.

RUN TIME LICENSE INSTALLATION

Run time license users will receive a file xdamp4XXXRT.zip or xdamp4XXXRT.exe to unzip. These are designed to unzip to the C:\xdamp directory. You may select a different drive letter before unzipping, but maintain the remainder of the file structure. Only the drive letter needs specification in the unzip process. After unzipping the distribution, start xdamp and agree to use the idl.ini initialization settings. Then read the readme.txt file for information on obtaining a license for your specific computer. At the present time, the run time installation is only supported on PC-based systems.

RESTRICTIONS

***xdamp* Version 4 must use IDL version 5.5 or later, for Macintosh, Unix and PC-based systems. *xdamp* works best with a three-button mouse (most seem to work) to operate on windows computers but this is no longer required (control-left mouse emulated the center button). A run-time IDL license for xdamp is available for one-quarter the cost of a full IDL license. Contact the author for details on obtaining *xdamp* with this software. There is a Sandia site licensed version of IDL that allows anyone to run *xdamp* without an individual IDL license.**

GETTING STARTED

The IDL environment variables must be defined as described in the IDL installation instructions for the specific computer environment. The *xdamp* files must be installed in the (publicly accessible) $IDL_PATH/lib/xdamp directory. Then the user can access *xdamp* simply by initiating IDL (type idl at the prompt or click on the icon) and then typing *xdamp* at the first IDL prompt. All subsequent inputs are funneled through the main *xdamp* window. If you install *xdamp* elsewhere, the IDL software will not automatically find *xdamp*.

For Unix systems, you can control the background color of the IDL widgets and the text font used for these widgets (the graphics font is completely independent). The following lines (with sample colors and font) may be inserted in your Xdefaults file. Be careful, if you choose too large a font, the graphics area will not be next to the controls and will be too small; if the screen does not appear similar to Fig. 1, then reduce the font size. I have had good success using a bold font for the widget font. Alternatively, reduce the graphics area size using the GRAPHIC AREA=XSIZExYSIZE in the initialization file (see next topic). You can also reserve a block of color indices so that other applications won't destroy the color maps with the last entry in the list below.

Idl*background: LightSteelBlue

Idl*foreground: Black

Idl*fontList: ROMB12

Idl.colors: 64 (the period, rather than asterisk, is correct here)

For PC systems, the wfont command in the **xdamp.ini** file allows control of the default fonts for buttons and the default appearance of IDL in general. Macintosh computers have a similar capability through the File Preferences menu.

INITIALIZATION FILE

There is an optional initialization file that may reside in the subdirectory from which you will execute *xdamp*. Its name must be **xdamp.ini**. Different versions may be in different subdirectories. The following commands, one per line, may be in this file in any order and will define the options preferences. The commands are not case sensitive, although the argument may be (for instance, the file filter). Further information on these controls may be found in the Options section (page 35). A sample **xdamp.ini** file resides in $IDL_PATH/lib/xdamp. Custom versions can easily be generated with the Write Initialization File button under the Options command. Runtime and site license installations expect the **xdamp.ini** file to reside in C:\xdamp or its equivalent.

TABLE 1. xdamp.ini Initialization File Commands

Controls this feature	Default	Alternates
Maximum number of waveforms	Maxarrays=	Default in **XIsys_sp.pro** or use **xdamp.ini** file
Maximum length of waveforms	Maxsize=	Default in **XIsys_sp.pro** or use **xdamp.ini** file
Maximum number of images	Maximages=	Default in **XIsys_sp.pro** or use **xdamp.ini** file
Maximum size of images	Maximagesize=1024x1024	Default in **XIsys_sp.pro** or use **xdamp.ini** file
Graphic area dimensions in pixels	Graphic Area=800x750	Default in **XIsys_sp.pro** or use **xdamp.ini** file
Maximum number of columns of waveform/image buttons	System specific, 2 or 3	BUTTONCOLUMNS=
Maximum number of lines of buttons before becoming scrollable	System specific, ~10	BUTTONLINES=
Cursor or prompt inputs	Cursor On	Cursor Off
Force numeric input for shifts	Selectable by user in OPTIONS menu	NOSHIFTBYCURSOR
Automatic plotting	Autoplot On	Autoplot Off
Clear Stack After Operation	Clear Stack Off	Clear Stack On
Print device	PS	CPS, NOPS
Print queue	Queue Name=	Default in **XIsys_sp.pro** or use **xdamp.ini** file, can be IP address of network printer
Plots/page	One/page	Two/page, Four/page
Date on plots	Todays Date	Shot Date
Plot all or sampled data	Plot all data	Plot sampled data
Pretty plot style	Pretty Off	Pretty On

TABLE 1. xdamp.ini Initialization File Commands

Controls this feature	Default	Alternates
Plot with symbols	Symbols Off	Symbols On
Screen plot colors	Monochrome	Color
Line thickness	Line thick=1.0	Number >0.2, <5.0
Grid appearance	Grid Off	Grid On, Grid Zero
Image plot style	Picture	Wire, Surface, Contour
Contour fill	Contour fill off	Contour Fill on
Contour lines	Contour line off	Contour line on
Number of contours	10	Any number
Windows font (PCs)	Wfont=SYSTEM	Any valid windows font such as Wfont=ARIAL*BOLD*14
Graphics font type	Hardware Font	Vector Font
Graphics Hardware Font[a]	Gfont=FONT	Font must be fully qualified[b]
Vector font size multiplier[c]	Font size = 1.0	Number >0.2, <5.0
Display max/min	Max/min On	Max/min Off
Display mean and standard deviation	Mean On	Mean Off
Display FWHM	FWHM On	FWHM Off
Display rise/fall	Rise/fall On	Rise/fall Off
Pulse parameter method	Best Guess	Peak Down, Ends In
Compare baseline fixed or variable during curve fit	Compare baseline variable	Compare baseline fixed
Default file filter	File filter=*.hdf	Any wildcard string
File data encoding for read (HDF auto recognized)	EXCEL	GUIDAS, EXCEL, SPICE, XYCE, Alegra, ASCII, USER
X-axis	Xlinear	Xlog
X-axis endpoints	Xrounded	Xexact, Xextended
X-axis zero in graphics area	Xzero On	Xzero Off
X-axis minor tick marks	Xminor Auto	Xminor Off
Y-axis	Ylinear	Ylog
Y-axis endpoints	Yrounded	Yexact, Yextended
Y-axis zero in graphics area	Yzero On	Yzero Off
Y-axis minor tick marks	Yminor Auto	Yminor Off
Z-axis	Zlinear	Zlog
Z-axis endpoints	Zrounded	Zexact, Zextended
Z-axis zero in graphics area	Zzero On	Zzero Off
Z-axis minor tick marks	Zminor Auto	Zminor Off

a. Valid only if Hardware Font selected

b. Example: -adobe-helvetica-medium-r-normal--14-140-75-75-p-77*

c. Valid only if Vector Font selected

You must be exceedingly careful when setting the graphics hardware font to choose a legal definition. If in doubt, leave this blank and use the xfont utility in the OPTIONS window to find a legal font name and then include it in the initialization file.

FINISHING UP

To leave *xdamp*, select FILE and then EXIT from the *xdamp* menu. This action returns you to the IDL prompt. Then type EXIT to return to the system prompt. On a Macintosh, *DO NOT* use the FILE.QUIT on the screen menu bar because this will not properly close the journal file or any other open files.

VERSION 4 CHANGES

Every feature of prior *xdamp* versions has been preserved in Version 4 except for reading of DAMP formatted data and possibly GIF file utilities (this depends on your license now). The major change is that the xdamp.ini file that is read as well as the journal and spreadsheet output files reside in the main xdamp folder. For full licenses, this is the C:\rsi\idl55\lib\xdamp folder and for runtime installations this is the C:\xdamp\bin\bin.x86 folder. There is one change affecting macro files; if you use the scale axis routine, a second input is needed in waveform mode that will be the new time units.

RUN TIME LICENSE DIFFERENCES

For the run time license installation, the initialization file, journal file, and spreadsheet files will be in the C:\xdamp\bin\bin.x86\ directory. Creating a shortcut for *xdamp* that starts in a different location than the default will cause the license software not to function properly. The USER data format is not available with the runtime license and the USERN custom procedures are unavailable with the run time license. The xdamp.ini file should reside in C:\xdamp or its equivalent if you install on another drive.

SITE LICENSE DIFFERENCES

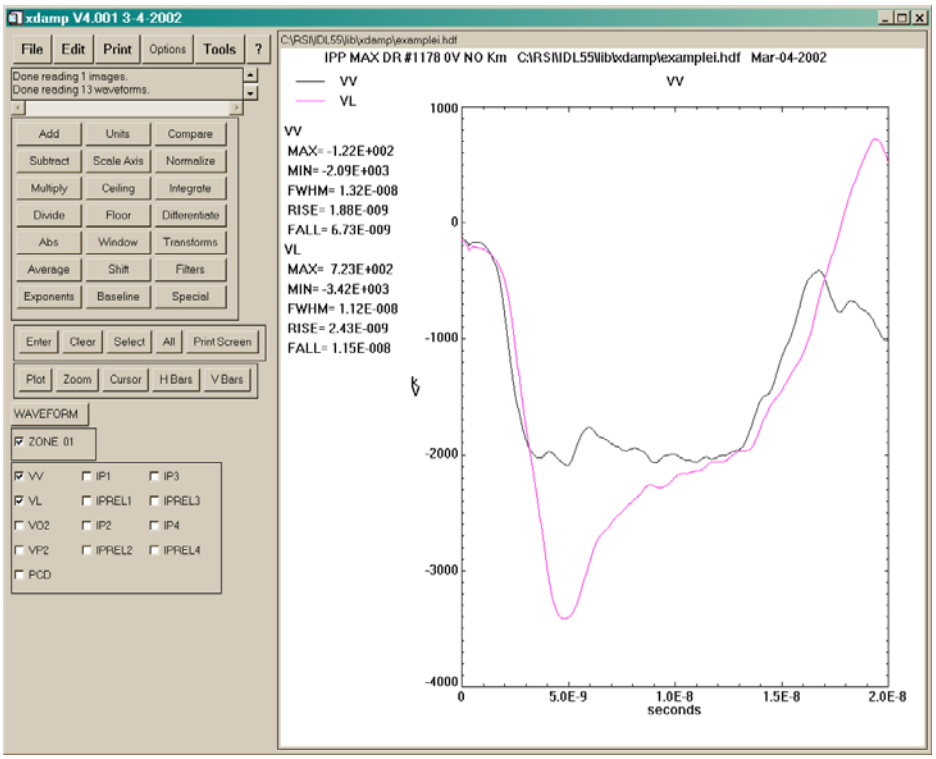
Sandians may get the site licensed stand-alone version of xdamp that includes a site license for IDL 5.6. Otherwise, the run time license limitations apply to this type of license.

If you are really brave, you can launch xdamp from a DOS batch file (xdamp.bat) that is provided. The syntax is xdamp.bat D:\data\filename.ext where D is the drive with the data file, data is the path to the data file and filename.ext is the actual file name. The xdamp.bat file must be edited to point to the actual installation of xdamp and the xdamp.ini file must be set up correctly or everything will fail quickly and silently. The xdamp.ini file which will be read should reside in the directory from which you will launch the xdamp.bat. For instance, if you are in directory e:\mydata and launch xdamp.bat via the call c:\xdamp\xdamp.bat e:\mydata\file17.dat then the xdamp.ini file should be in e:\mydata. Runtime license people need to also modify their idl.ini files to point explicitly to where they locate xdamp. This edit should be done prior to initial execution of xdamp, but can be changed later. Mail me for details.

Screen Layout

The *xdamp* screen (Fig. 1) is designed so that input from a virtual terminal is never needed. The *xdamp* title bar displays the current version number and the date of that version. The left portion of the screen contains all the menus and buttons needed. The right portion of the screen contains the graphics region and a label area for the active file name.

FIGURE 1. ***xdamp*** **screen layout in waveform mode**



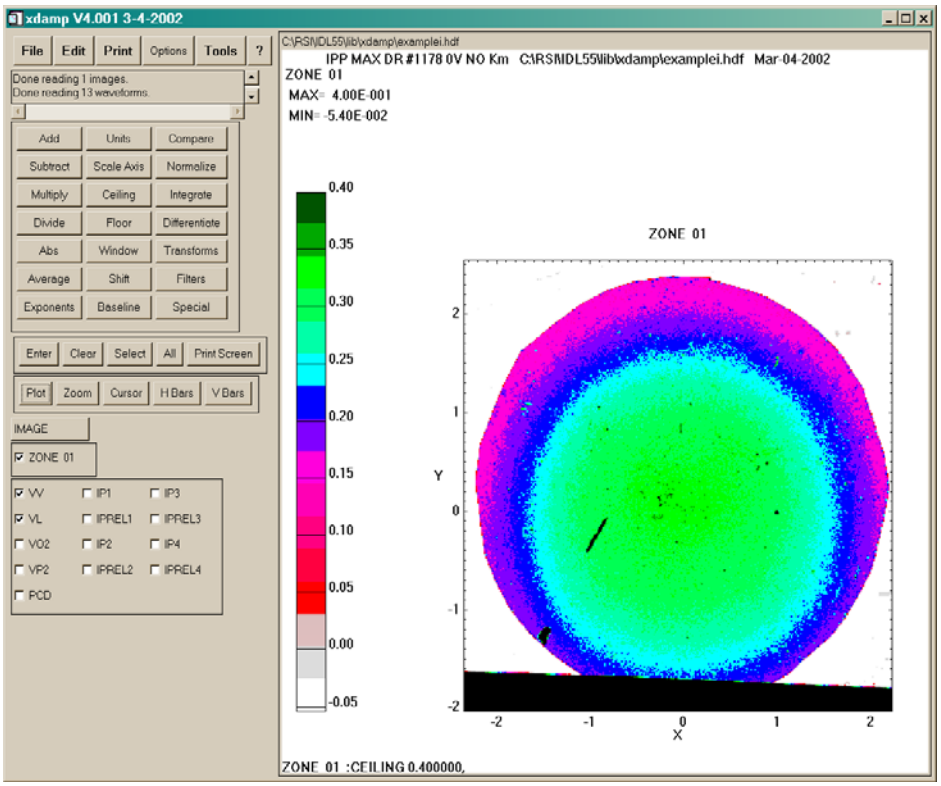
Across the top of the left portion of the *xdamp* screen is a series of “menu” buttons, not all of which actually lead to menus. The FILE, EDIT, PRINT, TOOL, and ? buttons lead to menus but the OPTIONS button pops a window with available option selections.

The space immediately below the menu bar contains a scrollable message area in which *xdamp* places output. Informational messages, general messages, error messages, and cursor values are shown in this area. For the sake of sanity, *xdamp* does not beep at you to alert you that a new message is present.

Below the message area is the operator box. Each button causes the operation described to be performed. In a few cases, such as the TRANSFORM button, subsets of further buttons appear. Only one operator button can be pressed at a time.

Below the operator area is the speed button area where buttons used extremely frequently are placed. In most cases, the same operation executed by pressing one of these buttons is available from one of the menus.

FIGURE 2. ***xdamp*** **screen layout in image mode**



Below the speed button area is the image/waveform mode selection button. Pressing this button toggles between plotting images or waveforms. Alternatively, simply selecting or deselecting an image or waveform will change modes.

Below the image/waveform mode button are the image buttons and the waveform buttons. One button is present for each of the waveforms. Multiple images/waveforms can be selected simply by pressing multiple buttons. Pressing an already set button deselects that waveform. Buttons may also be selected using wildcard strings by using the EDIT.SELECT menu selection or the Select speed button.

The following sections describe each of these actions in detail, beginning with the menus and proceeding down the left side of the screen. For the command equivalent, inputs that you choose are shown enclosed by the brackets <>. *The punctuation in the command equivalent is critical.* Also, although the command equivalents are shown with varying cases, the actual commands are converted to uppercase so the commands are case insensitive except for waveform/image names and file names. The notation FILE.OPEN means the OPEN subcommand from the FILE menu and is also the command equivalent.

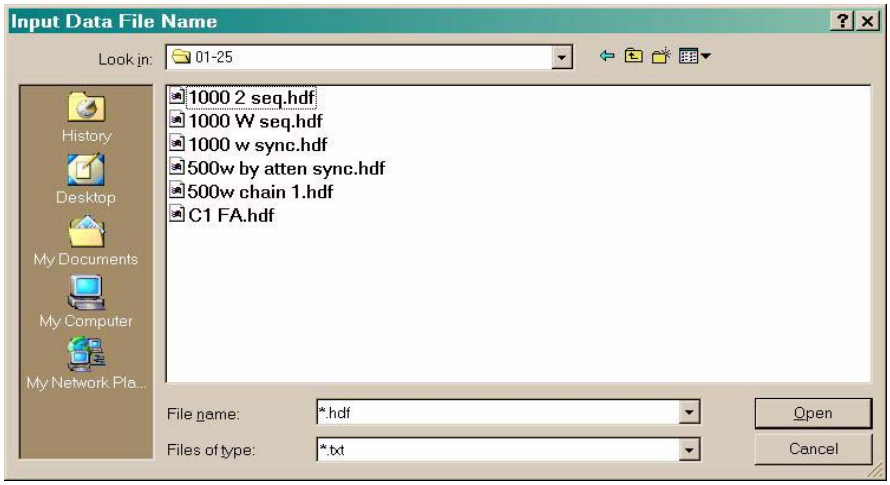
File Menu

FILE.OPEN

The FILE.OPEN menu selection pops a file selection widget (Fig. 3) to allow you to choose the data file to open. The default extension is defined by the case sensitive file filter defined in the initialization file or by the FILE.SET FILTER menu selection. It may be temporarily edited within the file selection widget. The widget allows you to move relatively freely between various directory tree structures. *Beware, only single mouse clicks are needed to move around on Unix systems.*

You should set the data storage type using the FILE.DATA TYPE menu item or the equivalent in the OPTIONS widget before trying to open a file. This command *automatically* discerns if the data file was written in HDF, and reads in the data appropriately. If records longer than the current maximum allowed are present, then the data are averaged over sets of points to reduce the record size. In automatic execution mode, you will *not* be queried about whether to save a currently open file when opening a new file.

FIGURE 3. Windows file selection widget



GUIDAS data files from the SPHINX accelerator are in ASCII format but have the header information in the file and use a format that saves the starting and ending times of the waveforms, rather than the entire time data set.

EXCEL data files can be either in comma delimited form (.csv) or tab delimited form (.txt). The number of data sets is automatically determined by counting the number of commas or tabs in the first row. The first row of the spreadsheet must contain the waveform names. The second row must contain the respective units. The first column of the spreadsheet is assumed to have time information in either HH:MM:SS format or in seconds. The HH:MM:SS format may contain date information that is stripped and both 12-hour (with AM or PM) and 24-hour formats are recognized. Uniform spacing in time is not assumed and the data will be resampled to either the smallest δt in the set or to the maximum number of allowed data points. If more data are present than the maximum size of the data arrays, the data are decimated by 1/2, possibly multiple times, and a note placed in the information area.

SPICE input data are from a Probe output file in .csd format. Generally, no editing of the data file is required. Uniform spacing in time is not assumed and the data will be resampled to either the smallest δt in the set or to the maximum number of allowed data points. If more data are present than the maximum size of the data arrays, the data are decimated by 1/2, possibly multiple times, and a note placed in the information area.

XYCE data are similar, except the first column is ignored because it contains just a data index. Otherwise, the data are treated as an EXCEL format.

ASCII waveform input data are in the format: name, horizontal axis units, vertical axis units, number of points and a set of x-y pairs, delimited by white space. The ASCII data need not be in order or have equally spaced points, *xdamp* will sort and then resample the waveform using the smallest time interval or to the maximum number of data points. ASCII image data are in the format: name, x-axis units, y-axis units, z-axis units, number of x-points, number of y-points, and then x, y, z data sets. Resampling is not supported for images. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.OPEN
<full path + file name> or ?

FILE.CLOSE

The FILE.CLOSE menu selection will close the active data set. If any modifications to the original data have been made, then you will be asked if you wish to save the data set before the images/waveforms are cleared out. If you answer yes, then the SAVE AS submenu will appear to obtain a file name for saving the data. If you have already saved the file, then the NO in the command equivalent is not needed.

Command Equivalent
FILE.CLOSE
NO

FILE.APPEND

The FILE.APPEND menu selection also uses the file selection widget to choose a file to be appended to the currently opened file. Each waveform/image in the appended file will have the shot number from the file name (if any) prefixed to the waveform/image name. If there is no shot number, then one or more plus signs (+) are prefixed to the waveform/image name. The number of these is determined by the number of append operations performed. The addition of the shot number or plus signs to each file name makes certain that the names are unique. When saving a file after an append operation, the default file name is still that of the initial file opened. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.APPEND
<full file name> or ?

FILE.GET DATA

The FILE.GET DATA menu selection uses the file selection widget to choose a data file. This file is opened and a widget with buttons for each waveform/image is presented. You choose which images/waveforms (which are automatically plotted) you

want to append to the currently opened data set and then press the DONE button. The waveform/image names will either have the shot number from the file name prefixed to the waveform/image names or a number of plus signs (+) that depends on the number of files opened. These images/waveforms are added to the current data set. Do not use this command if the target file has only one waveform, instead use FILE.APPEND. The command equivalent is shown below for adding two waveforms “WVFM1” and “WVFM2” to the data set. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.GET DATA
<full file name> or ?
WAVEFORM.WVFM1
WAVEFORM.WVFM2
DONE

FILE.IMPORT IMAGE.GIF

The FILE.IMPORT IMAGE.GIF menu selection pops a file selection widget to allow you to choose a file containing an image in GIF format. The image is translated and read into the database. If the image is too large for the allocated size, then it is resampled by choosing every second or third pixel and a warning is displayed. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ? Note that the GIF format is no longer supported by IDL for version 5.4 and over.

Command Equivalent
FILE.IMPORT IMAGE.GIF
<full file name> or ?

FILE.IMPORT IMAGE.HDF

The FILE.IMPORT IMAGE.HDF menu selection pops a file selection widget to allow you to choose a file containing an image in HDF Scientific Data Set (Spyglass) format. The image is translated and read into the database. If the image is too large for the allocated size, then it is resampled by choosing every second or third pixel and a warning is displayed. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.IMPORT IMAGE.HDF
<full file name> or ?

FILE.IMPORT IMAGE.JPG

The FILE.IMPORT IMAGE.JPG menu selection pops a file selection widget to allow you to choose a file containing an image in JPEG format. The image is translated and read into the database. If the image is too large for the allocated size, then it is resampled by choosing every second or third pixel and a warning is displayed. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.IMPORT IMAGE.JPG
<full file name> or ?

FILE.IMPORT IMAGE.PERKIN ELMER

The FILE.IMPORT IMAGE.PERKIN ELMER menu selection pops a file selection widget to allow you to choose a file containing an image in Perkin Elmer image scanner format. The image is translated and read into the database. If the image is too large for the allocated size, then it is resampled by choosing every second or third pixel and a warning is displayed. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.IMPORT IMAGE.PERKIN ELMER <full file name> or ?

FILE.IMPORT IMAGE.PICT

The FILE.IMPORT IMAGE.PICT menu selection pops a file selection widget to allow you to choose a file containing an image in PICT format. The image is translated and read into the database. If the image is too large for the allocated size, then it is resampled by choosing every second or third pixel and a warning is displayed. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.IMPORT IMAGE.PICT <full file name> or ?

FILE.IMPORT IMAGE.TECPLOT

The FILE.IMPORT IMAGE.TECPLOT menu selection pops a file selection widget to allow you to choose a file containing an image in Tecplot™ (available from Amtec Engineering) binary format. The image is translated and read into the database. If the image is too large for the allocated size, then it is resampled by choosing every second or third pixel and a warning is displayed. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.IMPORT IMAGE.TECPLOT <full file name> or ?

FILE.IMPORT IMAGE.TIFF

The FILE.IMPORT IMAGE.TIFF menu selection pops a file selection widget to allow you to choose a file containing an image in TIFF format. The image is translated and read into the database. If the image is too large for the allocated size, then it is resampled by choosing every second or third pixel and a warning is displayed. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.IMPORT IMAGE.TIFF <full file name> or ?

FILE.EXPORT IMAGE.EPS

The FILE.EXPORT IMAGE.EPS menu selection pops a file selection widget to allow you to choose a file name for saving the current plot area as an encapsulated postscript (EPS) data file. The default file extension is **.eps**. If you are in automatic execution

mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.EXPORT IMAGE.EPS <full file name> or ?

FILE.EXPORT IMAGE.GIF

The FILE.EXPORT IMAGE.GIF menu selection pops a file selection widget to allow you to choose a file name for saving the current plot area as a GIF data file. The default file extension is **.gif**. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?. Note that the GIF format requires separate licensing arrangements and may or may not work on your system.

Command Equivalent
FILE.EXPORT IMAGE.GIF <full file name> or ?

FILE.EXPORT IMAGE.JPEG

The FILE.EXPORT IMAGE.JPEG menu selection pops a file selection widget to allow you to choose a file name for saving the current plot area as a JPEG data file. The default file extension is **.jpg**. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.EXPORT IMAGE.JPEG <full file name> or ?

FILE.EXPORT IMAGE.PICT

The FILE.EXPORT IMAGE.PICT menu selection pops a file selection widget to allow you to choose a file name for saving the current plot area as a PICT data file. The default file extension is **.pic**. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.EXPORT IMAGE.PICT <full file name> or ?

FILE.EXPORT IMAGE.TIFF

The FILE.EXPORT IMAGE.TIFF menu selection pops a file selection widget to allow you to choose a file name for saving the current plot area as a TIFF data file. The default file extension is **.tif**. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent
FILE.EXPORT IMAGE.TIFF <full file name> or ?

FILE.SAVE

The FILE.SAVE menu selection overwrites the original data file with the current contents of the waveforms and images using the Hierarchical Data Format (HDF). If you have performed an append operation, the name of the first file opened is used. You are

asked if you are certain that you want to overwrite the original file before continuing with this operation *unless* you are in automatic execution mode.

Command Equivalent

FILE.SAVE

FILE.SAVE AS

The FILE.SAVE AS menu selection prompts for a new file name via the file selection widget so you can alter the directory, file name, or file extension before actually saving the waveforms and images using Hierarchical Data Format (HDF). The default file extension for a save as operation is **.hdf**. If the new and old file names are identical, you are asked if you are certain that you want to overwrite the original file before continuing with this operation. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name. You can modify the prompt by placing your query string after the ?.

Command Equivalent

FILE.SAVE AS
<full file name> or ?

FILE.SAVE ASCII

The FILE.SAVE ASCII menu selection saves the selected waveforms or images in an ASCII file suitable for editing and use by many external graphics packages. If more than one waveform/image is selected, then all selected waveforms are output in a single file. For waveforms, the output data format, on separate lines, is the keyword WAVEFORM, the waveform name, the horizontal axis units label, the vertical axis units label, the number of points, and then a series of x-y pairs separated by white space. For images, the output data format, on separate lines, is the keyword IMAGE, the image name, x-axis units label, the y-axis units label, the z-axis units label, the number of x points, the number of y points, and then (x, y, z) data tuples separated by white space. If no images/waveforms are selected, then all images or waveforms, depending on the current mode, are written to the output file. The output file name is chosen by the file selection widget with a default extension of **.asc**. If you are in automatic execution mode and use a ? instead of a full file name, you will be prompted for the desired file name You can modify the prompt by placing your query string after the ?.

Command Equivalent

FILE.SAVE ASCII
<full file name> or ?

FILE.SET FILTER

The FILE.SET FILTER menu selection asks for the new case sensitive file filter to be applied in future OPEN, SAVE, and SAVE AS operations. The file filter can be very sophisticated and use multiple wildcard characters (*) or simply specify the desired file extension. Example formats are ***.hdf** or ***77*.hdf** or **saturn_023*.dat**. Filters can also be set through the OPTIONS widget.

Command Equivalent

FILE.SET FILTER
<filter string>

FILE.SET DATA TYPE

The FILE.SET DATA TYPE menu selection pops a widget to set the format the data to be read were stored in. This has no effect on the output data formats. Possible responses are GUIDAS, EXCEL (comma or tab delimited), SPICE (probe .csd or .csv type), XYCE (default .csv type), ALEGRA, USER, or ASCII formats as well as a CANCEL

button if you don't want to change the current selection. File save operations always use the HDF format, no matter what data type is set. The USER format is distributed in the **XI_user.pro** procedure and is not accessible if you have a run-time license. The user may define this subroutine if desired The data type can also be set through the OPTIONS widget.

Command Equivalent
FILE.SET DATA TYPE EXCEL or SPICE or XYCE or GUIDAS or ALEGRA or ASCII or USER

FILE.EXIT

The FILE.EXIT menu selection exits *xdamp*. Prior to exiting, a FILE.CLOSE operation is performed, allowing you to save the current data set if you desire. Then, if any data remains in the print file, you are asked if you wish to spool it to the printer before exiting. This operation returns you to the IDL prompt, not the operating system. In command mode, the following sequence assumes you do not wish to save the active file. Also, an additional Yes or No may be needed if there is a print file open. The print question is asked before the question about saving the file.

Command Equivalent
FILE.EXIT YES or NO

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Edit Menu

In this context, all editing is done on images, waveforms, or a set of special storage registers. There are two methods to create new waveforms or images, NEW and COPY. These are very similar in end effect. There is no method to create a new register; you must use the predefined registers #R0 through #R9. Be aware that *xdamp* is case sensitive for waveform/image names so the names VV, Vv, vV, and vv are unique.

EDIT.STORE

The EDIT.STORE menu selection allows you to store a number in one of the predefined registers. A constant or the contents of another register can be stored in these registers.

Command Equivalent
EDIT.STORE <value or #register> <0 through 9>

EDIT.NEW

The EDIT.NEW menu selection creates a new waveform or image depending on the current mode. It prompts for the desired name of the new waveform/image. This name must be different from all other names of the same category in the current data base. All other data about the waveform/image is assumed to be blank until some operation targeting this waveform/image is performed. Then, the new waveform/image takes its properties (number of points, time span) from the other waveform/image in the operation.

Command Equivalent
EDIT.NEW <waveform or image name>

EDIT.COPY

The EDIT.COPY menu selection copies the last waveform/image selected to a new waveform/image. You are prompted for the new waveform/image name. If the new name is identical to an existing one, you will be asked if you are certain you wish to overwrite the old waveform/image. Should you answer affirmatively, the copy command will proceed, writing over the old data with the selected waveform or image. All other data are identical to the old waveform/image.

Command Equivalent
EDIT.COPY <waveform/image name>

EDIT.SORT

The EDIT.SORT menu selection sorts the waveform/image buttons in alphanumeric order from a to z within each category. The buttons are then rearranged.

Command Equivalent
EDIT.SORT

EDIT.RENAME

The EDIT.RENAME menu selection renames the last waveform/image selected to a new name obtained from a prompt window. The new name is forced to be unique compared to all current waveforms or images or the operation is not performed.

Command Equivalent

EDIT.RENAME
<new waveform/image name>

EDIT.SELECT

The EDIT.SELECT menu selection asks for a wild card waveform/image designation and then selects all of the waveforms/images meeting that criteria. At least one asterisk must be present in the response. For example, PIN* as the wild card input would select PIN, PIN1, and PIN007.

Command Equivalent

EDIT.SELECT
<wildcard string>

EDIT.DELETE

The EDIT.DELETE menu selection deletes all the selected waveforms/images and their buttons. There is no “Are you sure?” prompt. If you have insufficient memory failures, edit the **XI_edit.pro** file and find the **XIedit_delete** section. There is a comment with a note to uncomment one line and comment out another line to improve the memory management at the expense of speed.

Command Equivalent

EDIT.DELETE

EDIT.KEEP

The EDIT.KEEP menu selection deletes all waveforms/images except the selected waveforms/images. There is no “Are you sure?” prompt. If you have insufficient memory failures, edit the **XI_edit.pro** file and find the XIedit_keep section. There is a comment with a note to uncomment one line and comment out another line to improve the memory management at the expense of speed.

Command Equivalent

EDIT.KEEP

EDIT.RESTORE

The EDIT.RESTORE menu selection restores all the currently selected waveforms/images from the data file to their state after the last save operation.

Command Equivalent

EDIT.RESTORE

EDIT.NOTES

The EDIT.NOTES menu selection allows you to edit notes attached to each waveform/image. (Notes appear in the lower left corner of the graphics area when a single waveform/image is plotted.) These notes can be printed using the PRINT.NOTES COMMAND or viewed using the TOOLS.SHOW NOTES command. Editing areas for notes about all of the selected waveforms/images, or all waveforms/images if none are selected, will appear. In automatic execution, this command returns control to you for the input of notes. Automatic execution continues when you press the DONE button.

Command Equivalent

EDIT.NOTES

EDIT.FILE NOTES

The EDIT.FILE NOTES menu selection allows you to edit notes attached to the overall data set. An editing area for the notes will appear. These notes can be printed using the PRINT.FILE NOTES COMMAND or viewed using the TOOLS.SHOW FILE NOTES command. In automatic execution, this command returns control to you for the input of file notes. Automatic execution continues when you press the DONE button.

Command Equivalent
EDIT.FILE NOTES

EDIT.TITLE

The EDIT.TITLE menu selection allows you to edit the shot title information attached to the overall data set. An editing area for the title will appear. In automatic execution, this command returns control to you for the input of the shot title. Automatic execution continues when you press the RETURN key or DONE button.

Command Equivalent
EDIT.TITLE

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Print Menu

All printing is done using PostScript and is placed in a temporary file named **xdamp.out** in your current directory. To minimize paper, all printing occurs in append mode until you request that the file be queued. *xdamp* overrides the font selections when using PostScript output to be certain output will fit on the page. The **xdamp.out** file is not deleted upon exiting *xdamp* so you can reprint the file if needed.

PRINT.SCREEN

The PRINT.SCREEN menu selection causes the current graphics view to be redrawn to a file that can be printed later (see PRINT.QUEUE OUTPUT).

Command Equivalent
PRINT.SCREEN

PRINT.ALL

The PRINT.ALL menu selection causes all of the waveforms/images to be drawn to a file for later printing using the current selection of one, two, or four plots per page.

Command Equivalent
PRINT.ALL

PRINT.SELECTED

The PRINT.SELECTED menu selection causes all of the selected waveforms/images to be drawn to a file for later printing. The number of plots per page selection is honored for this process but only one plot to a plot area.

Command Equivalent
PRINT.SELECTED

PRINT.REGISTERS

The PRINT.REGISTERS menu selection causes the contents of the registers to be sent to the print file.

Command Equivalent
PRINT.REGISTERS

PRINT.SUMMARY

The PRINT.SUMMARY menu selection places a summary sheet in the file. For waveforms, the summary sheet contains the waveform name, maximum, minimum, vertical units, full width at half maximum, rise time, fall time and time units for each selected waveform. For images, the summary sheet contains the image name, maximum, minimum, x units, y units, and z units. If no waveforms/images are selected, the information for all waveforms/images is printed. This command also creates a comma-delimited ASCII file called **xdamp.csv** suitable for inclusion in a spreadsheet. In addition to the other outputs from the summary command, the spreadsheet contains the contents of the registers.

Command Equivalent
PRINT.SUMMARY

PRINT.HEADER

The PRINT.HEADER menu places the header (if one exists) of the original file opened, in the file for later printing.

Command Equivalent
PRINT.HEADER

PRINT.NOTES

The PRINT.NOTES menu selection places the notes for all the selected waveforms/images in the file for later printing. If no waveforms/images are selected, then all of the notes are printed.

Command Equivalent
PRINT.NOTES

PRINT.AUDIT TRAIL

The PRINT.AUDIT TRAIL menu selection places the audit trails for all the selected waveforms/images in a file for later printing. Audit trails are automatically generated for each image/waveform as you operate on them. If no waveforms/images are selected, then all of the audit trails are printed.

Command Equivalent
PRINT.AUDIT TRAIL

PRINT.FILE NOTES

The PRINT.FILE NOTES menu selection places the file notes in the printer file for later printing.

Command Equivalent
PRINT.FILE NOTES

PRINT.PRINTER TYPE

The PRINT.PRINTER TYPE menu selection pops a selection widget to choose the type of printer you have. You can either choose PS (PostScript) or CPS (Color PostScript) type printers or a Cancel button if the current selection is adequate. This can also be changed in the OPTIONS widget.

Command Equivalent
PRINT.PRINTER TYPE PS or CPS

PRINT.PRINTER SETUP

The PRINT.PRINTER SETUP menu selection invokes the native printer setup utility to allow selection of output printer and some customizing of the output.

Command Equivalent
PRINT.PRINTER SETUP

PRINT.QUEUE OUTPUT

The PRINT.QUEUE OUTPUT menu selection closes the current print file and queues it to the line printer for Unix systems. For Macintosh computers, you need to print out the **xdamp.out** file manually. One way to accomplish this is to use the shareware program DropPs available from mac.archive.umich.edu via anonymous ftp. For DOS/Windows machines, you need to make certain that the **idlspawn.pif** file was moved to the windows\system directory and was edited (using the PIF editor) to have the exclusive attribute set. On DOS/Windows machines (but not Windows 95 or NT), you will be stuck in DOS mode for the duration of the print.

Command Equivalent
PRINT.QUEUE OUTPUT

PRINT.QUEUE NAME

The PRINT.QUEUE NAME menu selection allows Unix system users to change print queue commands. The default is set in the **XIsys_sp.pro** file by the system manager.

The full command is required, for instance lpr -Psata002 would use the print command lpr with queue sata002. This feature also allows you to set print options.

Command Equivalent
PRINT.QUEUE NAME <queue print command + name>

PRINT.PRINTER RESET

The PRINT.PRINTER RESET menu selection closes the current print file and does not queue it to the printer. The second argument in the command equivalent is only required if there is an uncleared print file in the queue.

Command Equivalent
PRINT.PRINTER RESET YES or NO

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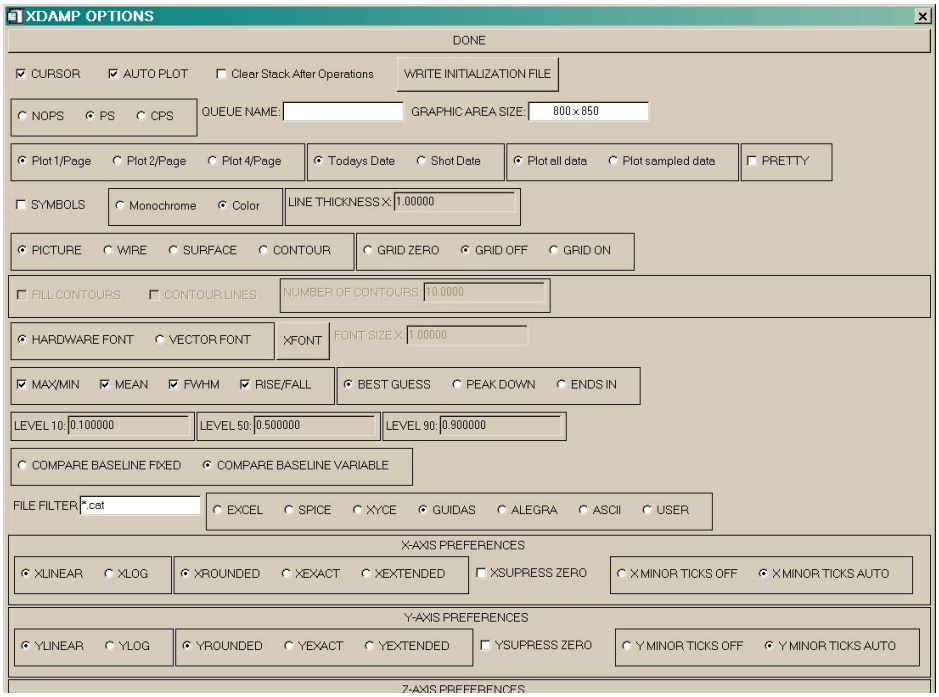
Options Window

Unlike the prior menus, the OPTIONS menu button pops up a window (Fig. 4) with a series of push buttons and input boxes. These allow you to select your preferred mode of viewing the data. All of the OPTIONS options may be set in the **xdamp.ini** file. The x-, y-, and z-axis preferences selections are identical and are only discussed under the equivalent x-axis heading. Multiple OPTIONS options may be placed in a series with the block of commands surrounded by the following commands. However, to perform even a single options command, you must surround it by these.

Command Equivalent
OPTIONS One or more commands here DONE

FIGURE 4. Options Window Layout



CURSOR

The CURSOR preference button determines how inputs will be given to *xdamp* for truncation, time shifting, zooming, and baselining operations. If the cursor button is down it is ON and the cursor will become active for these inputs. For shifting routines, selecting the NOSHIFTBYCURSOR command in your xdamp.ini file will force numeric input whatever the mode selected is. The current cursor coordinates are shown continuously in the message window. You must press a mouse button to pick the final desired cursor-

input position. If cursor mode is not selected, a numeric input box will automatically appear. Only a few operators, shown in Table 2, use the cursor.

TABLE 2. Operations that can use the cursor

Waveform Mode	Image Mode
CURSOR	CURSOR
H BARS	
VBARS	
ZOOM	ZOOM
BASELINE	BASELINE
SHIFT	SHIFT
CEILING	CEILING
FLOOR	FLOOR
WINDOW	WINDOW
INTERPOLATE	CENTER
DEFIDU	RHO PROFILE
CONCATENATE	LINE PROFILE
CALORIMETER	

The CURSOR command equivalent toggles the current state. In command mode, if the cursor preference is on, the automatic execution pauses for cursor input. If the cursor preference is off, the cursor position was saved (in data units) and is reused. Alternatively, you may use CURSOR ON or CURSOR OFF (with or without the OPTIONS and DONE) if you are uncertain of the state of the CURSOR command. The NOSHIFTBY-CURSOR option overrides all of the CURSOR options.

Command Equivalent
CURSOR or CURSOR ON or CURSOR OFF

AUTO PLOT

The AUTO PLOT preference button determines whether selected waveforms/images will be immediately plotted, or if the PLOT button must be used to make a plot. This is a toggle button. The command equivalent to toggle the state is shown below. Alternatively, you may use AUTO PLOT ON or AUTO PLOT OFF (with or without the OPTIONS and DONE) if you are uncertain of the state of the AUTOPLOT command.

Command Equivalent
AUTO PLOT or AUTO PLOT ON or AUTO PLOT OFF

Clear Stack After Operations

The Clear Stack after Operations preference button determines whether the stack will be automatically cleared after each operation. This is a toggle button. The command equivalent to toggle the state is shown below.

Command Equivalent
CLEAR STACK

MAKE INITIALIZATION FILE

The MAKE INITIALIZATION FILE button allows the creation of an **xdamp.ini** file containing all the currently enabled settings. The file selection widget allows you to

choose a different location or name for the initialization file but only the name **xdamp.ini** will be recognized at start-up.

PS
CPS
NOPS

The PS, CPS, and NOPS buttons are mutually exclusive. These determine what type of output device is in use. The PS button is monochrome PostScript and the CPS button is color PostScript while NOPS selects the printer chosen in the PRINT.PRINTER SETUP command as the output device.

Command Equivalent
PS or CPS or NOPS

QUEUE NAME

The QUEUE NAME input area allows Unix system users to change print queue commands. The default is set in the **XIsys_sp.pro** file by the system manager. The full command is required, for instance lpr -Psata002 would use the print command lpr with queue sata002.

Command Equivalent
QUEUE NAME = <Queue command and name>

GRAPHIC AREA SIZE

The GRAPHIC AREA SIZE input area allows you to interactively change the allowed plotting area. The default is set in the **XIsys_sp.pro** file by the system manager. The input is in pixels, (width x height) and the lower case x is required between the two arguments. The plotting area will resize when you hit a carriage return or the DONE button. This command is best set using the Graphic Area = command in the **xdamp.ini** initialization file.

Command Equivalent
GRAPHIC AREA = <Xpixels> x <Ypixels>

PLOT #/PAGE

The PLOT 1/PAGE, PLOT 2/PAGE, and PLOT 4/PAGE buttons are mutually exclusive. These determine whether one, two, or four plots per page will be shown both on the screen and for hardcopies.

Command Equivalent
PLOT 1/PAGE or PLOT 2/PAGE or PLOT 4/PAGE

SHOT DATE
TODAYS DATE

The SHOT DATE and TODAYS DATE buttons are mutually exclusive. If a shot date was encoded in the data file, then that date and time are shown on each plot when SHOT DATE is selected. Otherwise, if TODAYS DATE is selected, the current date is placed on each plot.

Command Equivalent
SHOT DATE or TODAYS DATE

PLOT ALL DATA
PLOT SAMPLED DATA

The PLOT ALL DATA and PLOT SAMPLED DATA buttons are mutually exclusive. If sampled data is selected, then a maximum of 1024 data points will be shown in each screen plot. Using ZOOM mode will override this selection which makes plotting much more rapid for large waveforms.

Command Equivalent
PLOT ALL DATA or PLOT SAMPLED DATA

PRETTY

The PRETTY button toggles between pretty mode and normal mode. Pretty mode suppresses the file name and shot date in the plot title as well as the audit trail printing. This allows nicer looking graphics to be generated for presentations. PRETTY OFF is the default.

Command Equivalent
PRETTY or PRETTY ON or PRETTY OFF

SYMBOLS

The SYMBOLS button determines whether symbols will be used on each plot in addition to the line. If it is pressed, then 25 symbols across the plot will be used. In command mode, this is a toggle command. Alternatively, you may use SYMBOLS ON or SYMBOLS OFF (with or without the OPTIONS and DONE) if you are uncertain of the state of the SYMBOLS command.

Command Equivalent
SYMBOLS or SYMBOLS ON or SYMBOLS OFF

MONOCHROME
COLOR

The MONOCHROME and COLOR buttons are mutually exclusive and choose what type of screen display will be generated. If COLOR is chosen, then all linetypes are solid while if MONOCHROME is chosen, all lines are different. The color map is determined by the TOOLS.COLOR TABLE. This button also determines whether PostScript output files are in color or black and white.

Command Equivalent
MONOCHROME or COLOR

LINE THICKNESS

The LINE THICKNESS MULTIPLIER determines how thick the graphics lines will be. The default is 1.0 and making lines too thick significantly slows down the graphics response. Valid values are between 0.2 and 5.0. The equals sign in the command equivalent is required.

Command Equivalent
LINE THICKNESS = <Line Thickness Multiplier>

GRID TYPE

The GRID ZERO, GRID OFF and GRID ON buttons are mutually exclusive. If GRID OFF is selected, no grid is shown. If GRID ON is selected, then a dotted grid is shown at the major tick marks. If GRID ZERO is selected, then only the x and y axis zero values of the grid are drawn as bold lines.

Command Equivalent
GRID ON or GRID OFF or GRID ZERO

PICTURE
WIRE
SURFACE
CONTOUR

The PICTURE, WIRE, SURFACE and CONTOUR buttons select the plotting mode for images. PICTURE treats the image as a 8-bit color bitmap when plotting. WIRE plots a 3-D wire frame version of the image. SURFACE plots a color, shaded 3-D wire frame view of the image. CONTOUR plots a contour level version of the image according to whether the contours are chosen to be filled and/or have lines at the different levels.

FILL CONTOURS

The FILL CONTOURS button selects whether the contour levels will be filled with solid colors. This choice is independent of the CONTOUR LINE selection.

CONTOUR LINES

The CONTOUR LINES button selects whether lines separating the contours are drawn. Used in conjunction with the independent FILL CONTOURS button, numerous different effects are possible.

NUMBER OF CONTOURS

The NUMBER OF CONTOURS entry box allows you to choose the number of contour levels desired in the plot. The equals sign in the command equivalent is required.

Command Equivalent
NUMBER OF CONTOURS = <Number>

HARDWARE FONT
VECTOR FONT

The VECTOR FONT button selects the IDL Hershey vector fonts for the graphics area. The HARDWARE FONT button selects the terminal default. The hardware fonts can be changed through either the XFONT button or the TOOLS.XFONT menu item for Unix systems.

Command Equivalent
VECTOR FONT or HARDWARE FONT

GRAPHICS FONT SIZE

The GRAPHICS FONT SIZE MULTIPLIER is only active for vector fonts. It modifies all the text in the graphics window. Valid values are 0.2 to 5.0. If you have selected hardware fonts, this field is inactive and the font size multiplier is set to 1.0. The equals sign in the command equivalent is required.

Command Equivalent
FONT SIZE = <Font Size Multiplier>

XFONT

The XFONT button pops up the xfont selector widget if HARDWARE FONT has been selected on Unix computers. This widget allows you to preview and select a hardware font from all of those available to your terminal. This font becomes the graphics area font. This application has no command equivalent but a desired font can be placed in the **xdamp.ini** file. This application does not function for Macintosh or Windows computers.

MAX/MIN

The MAX/MIN toggle button selects whether the maximum and minimum values of the selected waveforms/images will be shown on the left side of each plot (in ONE/page mode). This button is not mutually exclusive with either the FWHM or RISE/FALL buttons. These quantities are calculated every time a waveform/image is plotted, whether or not MAX/MIN is selected, and are stored in registers. Alternatively, you may use MAX/MIN ON or MAX/MIN OFF (with or without the OPTIONS and DONE) if you are uncertain of the state of the MAX/MIN command.

Command Equivalent
MAX/MIN or MAX/MIN ON or MAX/MIN OFF

MEAN

The MEAN toggle button selects whether the mean and standard deviation of the waveform (but not images) will be shown on the left side of each plot. (in ONE/Page mode only). This button is not mutually exclusive with any of the other buttons. These quantities are calculated every time a waveform/image is plotted, whether or not MEAN is selected, and are stored in registers. Alternatively, you may use MEAN ON or MEAN

OFF (with or without the OPTIONS and DONE) if you are uncertain of the state of the MEAN command.

Command Equivalent
MEAN or MEAN ON or MEAN OFF

FWHM

The FWHM toggle button selects whether the full-width at half-maximum (FWHM) values of the selected waveforms will be shown on the left side of each plot (in ONE/page mode). This button is not mutually exclusive with either the MAX/MIN or RISE/FALL buttons. This quantity is calculated every time a waveform is plotted, whether or not FWHM is selected, and is stored in a register. Alternatively, you may use FWHM ON or FWHM OFF (with or without the OPTIONS and DONE) if you are uncertain of the state of the FWHM command.

Command Equivalent
FWHM or FWHM ON or FWHM OFF

RISE/FALL

The RISE/FALL toggle button selects whether the 10%-to-90% rise-time and fall-time values of the selected waveforms will be shown on the left side of each plot (in ONE/page mode). This button is not mutually exclusive with either the MAX/MIN or FWHM buttons. These quantities are calculated every time a waveform is plotted, whether or not RISE/FALL is selected, and are stored in registers. Alternatively, you may use RISE/FALL ON or RISE/FALL OFF (with or without the OPTIONS and DONE) if you are uncertain of the state of the RISE/FALL command.

Command Equivalent
RISE/FALL or RISE/FALL ON or RISE/FALL OFF

BEST GUESS

The BEST GUESS button is mutually exclusive with the PEAK DOWN and ENDS IN buttons. It selects the mode used to calculate the FWHM and rise and fall times. The algorithm used calculates all parameters using both the PEAK DOWN and ENDS IN techniques. The longest FWHM and the shortest rise and fall times are then selected.

Command Equivalent
BEST GUESS

PEAK DOWN

The PEAK DOWN button is mutually exclusive with the BEST GUESS and ENDS IN buttons. It selects the mode used to calculate the FWHM and rise and fall times. The algorithm is to calculate all parameters starting from the waveform peak and proceeding outward to find the first 90%, 50%, and 10% values for the calculations.

Command Equivalent
PEAK DOWN

ENDS IN

The ENDS IN button is mutually exclusive with the BEST GUESS and PEAK DOWN buttons. It selects the mode used to calculate the FWHM and rise and fall times. The algorithm is to calculate all parameters starting from the beginning and the end of the waveform to find the first 10%, 50% and 90% values for the calculations.

Command Equivalent
ENDS IN

COMPARE BASELINE FIXED

The COMPARE BASELINE FIXED button is mutually exclusive with the COMPARE BASELINE VARIABLE button. These buttons control how the COMPARE routine performs curve fits. In fixed mode, the baseline is not allowed to vary and the two waveforms are fit by the equation Reference= Scale*Variable. No offset is allowed.

Command Equivalent
COMPARE BASELINE FIXED

COMPARE BASELINE VARIABLE

The COMPARE BASELINE VARIABLE button is mutually exclusive with the COMPARE BASELINE FIXED button. These buttons control how the COMPARE routine performs curve fits. In variable mode, the baseline is allowed to vary and the two waveforms are fit by the equation Reference= Scale*Variable + Offset.

Command Equivalent
COMPARE BASELINE VARIABLE

FILE FILTER

The FILE FILTER entry box allows you to change the default file filter to be applied in future OPEN, SAVE, and SAVE AS operations. This is identical to changing the filter in the FILE.SET FILTER menu selection. The file filter can be very sophisticated and use multiple wild card characters (*) or simply specify the desired file extension. Example formats are ***.hdf** or **saturn_012*.dat**.

Command Equivalent
FILE FILTER = <filter string>

DATA FORMAT

The DATA FORMAT selection buttons allow you to change the default data structure for the input file. Whatever the selection is, HDF files are always automatically recognized for reading. This command is identical to changing the selection in the FILE.SET DATA TYPE menu selection. The EXCEL format reads comma or tab delimited spreadsheet format data assuming the first line contains waveform names and the second line contains units. The first column is assumed to be time in HH:MM:SS.S format or simply in seconds. Date information may be present and is stripped. The time information may be either seconds, 12-hour (with AM or PM) or 24-hour. The number of columns is automatically determined by counting the commas or tabs. The SPICE format is assumed to be in the Probe .csd format. The XYCE format is similar to EXCEL format except the first column is an index that is ignored on read. Data do not need to be evenly spaced in time for EXCEL, XYCE, SPICE, and ASCII formats, they are resampled to an evenly spaced condition limited only by the maximum number of possible points in the waveform. The ALEGRA format currently only reads the Cabana waveforms in an Alegra HISPLOT output file. The USER format is in the file **XI_user.pro** segment of the **XI_file.pro** file and must be written by the user.

Command Equivalent
EXCEL or SPICE or XYCE or GUIDAS or ALEGRA or ASCII or USER

LINEAR

The LINEAR button is mutually exclusive with the LOG button. This selects whether the axis will be linear or logarithmic.

Command Equivalent
XLINEAR or YLINEAR or ZLINEAR

LOG

The LOG button is mutually exclusive with the LINEAR button. This selects whether the axis will be linear or logarithmic. For log axes, negative and zero values are ignored.

Command Equivalent
XLOG or YLOG or ZLOG

ROUNDED

The ROUNDED button is mutually exclusive with the EXACT and EXTENDED buttons. This selects rounded axis limits where IDL chooses the axis limits after examining the waveforms/images.

Command Equivalent
XROUNDED or YROUNDED or ZROUNDED

EXACT

The EXACT button is mutually exclusive with the ROUNDED and EXTENDED buttons. This selects exact axis limits and IDL chooses the axis limits after examining the waveforms/images.

Command Equivalent
XEXACT or YEXACT or ZEXACT

EXTENDED

The EXTENDED button is mutually exclusive with the ROUNDED and EXACT buttons. This selects extended axis limits where IDL chooses the axis limits after examining the waveforms/images and then adds approximately 20% to both ends.

Command Equivalent
XEXTENDED or YEXTENDED or ZEXTENDED

SUPPRESS 0

The SUPPRESS 0 toggle button is not mutually exclusive with the ROUNDED, EXACT and EXTENDED buttons. Normally, IDL will choose to have the value 0 included in the axis limits for both axes. This button removes this restriction and is akin to ac-coupling an oscilloscope.

Command Equivalent
XSUPPRESS ZERO or YSUPPRESS ZERO or ZSUPPRESS ZERO

MINOR TICKS AUTO

The MINOR TICKS AUTO button is mutually exclusive with the MINOR TICKS OFF button. This enables minor axis tick marks and IDL chooses the spacing after examining the waveforms/images.

Command Equivalent
X MINOR TICKS AUTO or Y MINOR TICKS AUTO or Z MINOR TICKS AUTO

MINOR TICKS OFF

The MINOR TICKS OFF button is mutually exclusive with the MINOR TICKS AUTO button. This disables minor axis tick marks.

Command Equivalent
X MINOR TICKS OFF or Y MINOR TICKS OFF or Z MINOR TICKS OFF

Tools Menu

TOOLS.MACRO

The TOOLS.MACRO menu has two sub-menu selections: Single File and Sequence of Files. Both of these modes require a command file (the default extension is **.dcf**) composed of a sequence of *xdamp* commands (see Table 3 for an example). The appropriate command file equivalent is listed at the end of each command description. You can incorporate comments into your command files by placing a semicolon at the beginning of the line. These comments will be echoed in the message area of the *xdamp* window during execution. Whitespace lines are ignored and can be inserted to make the command file easier to read but do not end a file with whitespace or comments. The single file version of this command can be used to nest macros up to 10 deep. The sequence of files macro is not callable in a macro.

TABLE 3. Sample Macro to calculate power-weighted mean voltage.

```
; Macro to calculate power and power-weighted mean voltage
; from synchronized load voltage waveform VL and load current IL
; Always start with CLEAR.
CLEAR
; Copy voltage to a new waveform named Power
WAVEFORM.VL
EDIT.COPY
Power
; Now enter the Power waveform prior to multiplying by current.
CLEAR
WAVEFORM.Power
ENTER
WAVEFORM.IL
MULTIPLY
; Now fix up units of new waveform for future reference.
CLEAR
WAVEFORM.Power
UNITS
seconds
MW
; Copy Power to a new waveform to make the power-weighted mean
CLEAR
WAVEFORM.Power
EDIT.COPY
PWMV
;Enter the new waveform and multiply by VL to get V*V*I
CLEAR
WAVEFORM.PWMV
ENTER
WAVEFORM.VL
MULTIPLY
; Fix the units on this waveform too.
```

TABLE 3. Sample Macro to calculate power-weighted mean voltage.

```
CLEAR
WAVEFORM.PWMV
UNITS
seconds
kV*MW
; Manually truncate the PWMV and Power waveforms to the region of interest
CLEAR
WAVEFORM.PWMV
WAVEFORM.Power
CURSOR ON
WINDOW
; Integrate the Power to get energy
CLEAR
WAVEFORM.Power
INTEGRATE
; Fix units of integrated power waveform INT_Power
UNITS
seconds
MJoules
; Store maximum energy in register 0 for later use.
EDIT.STORE
#MAX
0
; Divide the PWMV waveform by the energy in register 0
CLEAR
WAVEFORM.PWMV
DIVIDE
#R0
; Fix the units of PWMV
UNITS
seconds
kV/s
; Plot the final result - the integral will give the averaged PWMV
INTEGRATE
UNITS
seconds
kV
EDIT.STORE
#MIN
0
; Register zero now has PWMV in volts
```

TOOLS.MACRO.Single File

The single-file mode will pop the file selection widget to select an *xdamp* command file. This command file will then be executed and you will be returned to *xdamp*. The **xdamp.ini** file is not executed and the waveform/image buttons are left as is. Thus, you

can select a waveform/image and then perform a calculation on that waveform. To add a macro within another macro, use the following command syntax.

Command Equivalent
TOOLS.MACRO.SINGLE FILE <full file name>

TOOLS.MACRO.Sequence of Files

The sequence-of-files selection pops the file selection widget three times. The first time, you are asked to pick the beginning data file of a sequence, the second time you pick the final data file, and the third time you choose the command file to operate on each of these files. Each file is automatically opened and closed, so you do not need to perform these operations in the command file. However, you must perform an explicit FILE.SAVE operation in the command file or the modifications to the data will not be permanently saved. The **xdamp.ini** file will be automatically executed prior to opening each file so that a known initial state is present. This option allows an easy way to translate a group of files to HDF format. Simply create a one line command file containing the command FILE.SAVE. Modify your **xdamp.ini** to reflect the data format and extension that you will be translating from. When you perform automatic multiple file execution, the original data files will be overwritten with HDF data files.

You need to be very careful of the state of *xdamp* when you begin an automatic execution. *xdamp* does not clear all of the waveform/image selection buttons and does not initialize many variables in single file execution mode. However, the initialization file is executed for the initial command file of a nested set and for each pass through a sequence of files loop. If you must assume a particular waveform/image selection state, it is wise to perform a CLEAR operation in your command file and select the desired waveforms prior to executing the operation.

TOOLS.SHOW REGISTERS

The TOOLS.SHOW REGISTERS menu selection pops a widget that shows the name and contents of each register. No action is taken and the widget remains visible until you press the DONE button. This selection has the command equivalent shown below but you must manually press the DONE button to continue with automatic execution.

Command Equivalent
TOOLS.SHOW REGISTERS

TOOLS.SHOW LIMITS

The TOOLS.SHOW LIMITS menu selection pops a widget that displays the current limits on the number and length of waveforms and the number and size of images. This selection has the command equivalent shown below but you must manually press the DONE button to continue with automatic execution. To change the limits, you must exit *xdamp* and edit your initialization file to change the MAXARRAYS= and/or MAXSIZE= commands to the new limits.

Command Equivalent
TOOLS.SHOW LIMITS

TOOLS.SHOW NOTES

The TOOLS.SHOW NOTES menu selection pops a widget that shows the name and contents of each note associated with a waveform. No action is taken and the widget remains visible until you press the DONE button. You cannot edit the notes with this selection, instead use EDIT.NOTES. This selection has the command equivalent shown

below but you must manually press the DONE button to continue with automatic execution.

Command Equivalent
TOOLS.SHOW NOTES

TOOLS.SHOW AUDIT TRAIL

The TOOLS.SHOW AUDIT TRAIL menu selection pops a widget that shows the name and contents of each audit trail associated with a waveform. No action is taken and the widget remains visible until you press the DONE button. You cannot edit the audit trails with this selection, only view them. This selection has the command equivalent shown below but you must manually press the DONE button to continue with automatic execution.

Command Equivalent
TOOLS.SHOW AUDIT TRAIL

TOOLS.SHOW FILE NOTES

The TOOLS.SHOW FILE NOTES menu selection pops a widget that shows the file notes. No action is taken and the widget remains visible until you press the DONE button. You cannot edit the file notes with this selection, instead use EDIT.FILE NOTES. This selection has the command equivalent shown below but you must manually press the DONE button to continue with automatic execution.

Command Equivalent
TOOLS.SHOW FILE NOTES

TOOLS.SHOW HEADER

The TOOLS.SHOW HEADER menu selection pops a widget that shows the file header information. No action is taken and the widget remains visible until you press the DONE button. You cannot edit the header information with this selection, instead use EDIT.HEADER. This selection has the command equivalent shown below but you must manually press the DONE button to continue with automatic execution.

Command Equivalent
TOOLS.SHOW HEADER

TOOLS.XFONT

The TOOLS.XFONT menu selection pops up the xfont selector widget on Unix systems. This widget allows you to preview and select a hardware font from all of those available to your terminal. This font becomes the graphics area font. This application has no command equivalent but can be placed in the **xdamp.ini** file.

TOOLS.COLOR TABLE

The TOOLS.COLOR TABLE menu selection pops up a widget used to load any of the standard color tables. Use this application to change to reverse video mode in the graphics area by using the options section and selecting reverse color table. This selection has the command equivalent shown below but you must manually press the DONE button to continue with automatic execution.

Command Equivalent
TOOLS.COLOR TABLE

TOOLS.PALETTE

The TOOLS.PALETTE menu selection pops up a widget used to select color palettes. Thus, you can change a color table by modifying the specific colors. This selection has no command equivalent.

Help Window

Pressing the ? button will activate a sub menu allowing access to either the *xdamp* help or the IDL help widget. This latter choice is equivalent to typing a question mark at the IDL prompt. By pressing the *xdamp* button in the widget, An Adobe PDF reader opens the manual for version 5.6 and later. Otherwise, an information window pops telling you to open the xdampmanual.pdf file. The ? button is ignored in automatic execution mode.

This method allows the help window to co-exist with the *xdamp* window rather than blocking *xdamp* until the help window is dismissed.

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Operators

OPERATOR OVERLOADING

There are two types of operators in *xdamp*; single-waveform/image operators and multiple-waveform/image operators. As a consequence, the behavior of the operators is slightly different.

For single-waveform/image operators (i.e. ABS, SHIFT, BASELINE), if multiple waveforms/images are selected, the same operation is performed on all of the selected waveforms/images.

For multiple-waveform/image operators, if multiple waveforms/images are selected, then a constant to operate on all the selected waveforms/images is requested. If you wish to perform a multiple waveform/image operation on two waveforms/images (i.e. add two waveforms/images), then the first waveform/image must be selected and then ENTERed.

If no waveforms/images at all have been selected, then it is assumed that you wish to perform register arithmetic on the pre-defined registers #R0 through #R9 for the following operators: ADD, SUBTRACT, MULTIPLY, DIVIDE, ABS, INVERSE, POWER, SQRT, LOG, LN, EXP, 10^.

Thus, many of the operators are overloaded and operate on registers, single waveforms, single images, multiple waveforms in two possible modes, or multiple waveforms. Addition of waveforms to images is not supported.

TABLE 4. Automatic Register Names

Register Name	Quantity
#NX	Number of points in waveform or x points in image
#NY	Number of y points in image
#DX	Δt for waveform or dx for image
#DY	dy for image
#XMIN	Minimum time of waveform or minimum x of image
#XMAX	Maximum time of waveform or maximum x of image
#YMIN	Minimum y of image
#YMAX	Maximum y of image
#MIN	Minimum of waveform
#MAX	Maximum of waveform
#PEAK	Peak value of waveform/image (sign sensitive)
#XATMIN	Time or x-value at minimum
#XATMAX	Time or x-value at maximum
#XATPEAK	Time or x-value at peak
#MEAN	Mean of waveform
#STDDEV	Standard deviation of waveform
#YATMIN	Y-value at minimum

TABLE 4. Automatic Register Names

Register Name	Quantity
#YATMAX	Y-value at maximum
#YATPEAK	Y-value at peak
#FWHM	Full-width-at-half-maximum of waveform
#RISE	10%-90% rise time of waveform
#FALL	90%-10% fall time of waveform
#XSHIFT	Time shift from COMPARE
#YATX	Y value from Y at X command
#XATY1	First X value from X at Y command
#XATY2	Second X value from X at Y command
#XATY3	Third X value from X at Y command
#XATY4	Fourth X value from X at Y command
#SCALE	Scale factor from COMPARE
#OFFSET	Offset from COMPARE
#RSQRD	Statistical R^2 value from COMPARE
#CURSORX	Time or x value from last Cursor operation
#CURSORX2	Second time or x value from H BARS or V BARS
#CURSORDX	Delta time or x from last H BARS or V BARS command
#CURSORY	y value of last Cursor operation
#CURSORY2	Second y value from H BARS or VBARS command
#CURSORDY	Delta y from last H BARS or V BARS command
#CURSORZ	z value of last Cursor operation
#INTERCEPT	Intercept from Calorimeter operation
#R0 - #R9	User number registers

When entering a constant to operate on single or multiple waveforms/images there are two possibilities. You can enter an explicit number in free format, or you can use one of the registers (assuming it is loaded). The registers are all prefixed with the character #. A variety of registers are automatically loaded during each plot operation when the pulse parameters are calculated. These are shown in Table 4. *The values come from the last waveform/image selected and plotted.* The peak register will be the maximum if the absolute value of the maximum is greater than the absolute value of the minimum, otherwise it is the minimum value.

All of the single- and multiple-waveform/image operators have similar command file sequences (see Table 3 for an example). The single-waveform/image operators allow the selection of as many waveforms/images as desired and then use the command sequence below to execute the command “AARDVARK”.

Command Equivalent

AARDVARK

If the operator requires a constant input, it is provided in the following manner on the next line of the command file. If performing a cursor operation and the cursor preference is on, the command file temporarily becomes interactive. You may wish to dynamically prompt for a numeric input during automatic execution. To do this, replace the <number or #register> in the following table with a question mark followed immediately by a prompt string without quotes. The prompt string will become the title of the input box and you will be prompted for the information to be loaded in the register.

Command Equivalent
<number> or <#register> or ?PROMPT STRING

Multiple-waveform/image operators all operate in one of two modes: operating on two waveforms/images or operating on many waveforms/images with the same constant. When a first waveform/image is selected, followed by an ENTER, and then a second waveform/image is selected, followed by pressing an operator button, the second waveform/image is added to the first. The first waveform/image is overwritten by the operation on both waveforms/images after truncating the first waveform/image to the common time domain and resampling the second waveform/image if necessary. The second waveform/image is not modified. The command equivalent form of multiple-waveform/image operations for the ADD routine is shown next, including the waveform/image selection portion, where test1 is the waveform/image to be modified and test2 is to be added to test1.

Command Equivalent
WAVEFORM.test1
ENTER
WAVEFORM.test2,
ADD

In the second mode of operation, if one or more waveforms/images are selected without an ENTER, then you are prompted for a constant to operate on all of the waveforms/images selected. All of them are modified by this process. The command equivalent will require a <variable value> line after the operator command to perform correctly unless the operator uses the cursor and cursor mode is on. In this situation, the program pauses for cursor movement so you can interact with *xdamp*. Below is the command sequence (notice the lack of an ENTER command) to add the constant 3.95 to several images.

Command Equivalent
IMAGE.test1
IMAGE.test2
ADD
3.95

ADD

ADD is a multiple-waveform/image operator that adds waveforms/images together, numbers to waveforms/images, or numbers to registers. This command modifies the ENTERed waveform/image or all of the selected waveforms/images.

SUBTRACT

SUBTRACT is a multiple-waveform/image operator that subtracts waveforms/images from each other, numbers from waveforms/images, or numbers from registers. This command modifies the ENTERed waveform/image or all of the selected waveforms/images.

MULTIPLY

MULTIPLY is a multiple-waveform/image operator that multiplies waveforms/images by each other, waveforms/images by a number, or registers by a number. This command modifies the ENTERed waveform/image or all of the selected waveforms/images.

DIVIDE

DIVIDE is a multiple-waveform/image operator that divides waveforms/images by each other, waveforms/images by a number, or registers by a number. This command modifies the ENTERed waveform/image or all of the selected waveforms/images. Zero values of the divisor are masked out so numerical errors are trapped.

ABS

ABS is a single-waveform/image operator that takes the absolute value of waveforms/images or registers. This command modifies all of the selected waveforms/images.

AVERAGE

AVERAGE is a multiple-waveform/image operator that averages all selected waveforms/images and places the result in a new waveform/image with the name of the first selected waveform/image prefixed by “AVG_”. This command does not modify any of the waveforms/images.

EXPONENTS

EXPONENTS pops a window (Fig. 5) to select among the various power, logarithm, and inverse logarithm single-waveform/image operators: POWER, INVERSE, SQRT, EXP, LN, 10^, LOG. These modify all of the selected waveforms/images or the register chosen. A typical command sequence is shown, assuming the waveforms/images have already been selected.

Command Equivalent
EXPONENTS
POWER

FIGURE 5. EXPONENTS subwindow

POWER

POWER is a single-waveform/image operator that takes a waveform/image or register to an *integer* power. This command modifies all of the selected waveforms/images. For non-integer powers, use EXP(f*LN(array)) where f is the non-integer power.

INVERSE

INVERSE is a single-waveform/image operator that takes the inverse (1/x) of waveforms/images or a register. This command modifies all of the selected waveforms/images.

SQRT

SQRT is a single-waveform/image operator that takes the square root of waveforms/images or registers. This command modifies all of the selected waveforms/images.

EXP

EXP is a single-waveform/image operator that takes *e* raised to the waveform/image or *e* to the register. This command modifies all of the selected waveforms/images.

LN

LN is a single-waveform/image operator that takes the natural logarithm of the waveform/image or register. This command modifies all of the selected waveforms/images.

PWR10

PWR10 is a single-waveform/image operator that takes 10 raised to the waveform/image or register. This command modifies all of the selected waveforms/images.

LOG10

LOG10 is a single-waveform/image operator that takes the base-10 logarithm of the waveform/image or register. This command modifies all of the selected waveforms/images.

UNITS

UNITS is a single-waveform/image operator that allows you to change all of the axis-units labels for one or more waveforms/images. This command modifies all of the selected waveforms/images. Its command equivalent requires two or three additional inputs depending whether you are in waveform or image mode

Command Equivalent
UNITS <time or x units string> <amplitude or y units string> <amplitude units string> (image mode only)

SCALE AXIS

SCALE AXIS is a single-waveform/image operator that allows you to change the axis scales and unit names for one or more waveforms/images. This command does not allow you to modify the vertical axis scale, use multiply or divide instead. This command modifies all of the selected waveforms/images. Its command equivalent requires two additional inputs. The sense of the second input differs between waveform mode and image mode. In waveform mode, the second input is the axis unit name while in image mode the second input is the y-axis scale factor.

Command Equivalent
SCALE AXIS <time or x scaling factor> <time units or y scaling factor> (waveform or image mode)

CEILING

CEILING is a single-waveform/image operator that truncates the waveforms/images at values above those determined by the cursor or manual input. Cursor input does not work for image mode. This command modifies all of the selected waveforms/images.

FLOOR

FLOOR is a single-waveform/image operator that truncates the waveforms/images at values below those determined by the cursor or manual input. Cursor input does not work for image mode. This command modifies all of the selected waveforms/images.

WINDOW

WINDOW is a single-waveform/image operator that truncates the waveforms or images within a window defined by a box cursor or a series of numbers, depending on the cursor preference setting. This command modifies all of the selected waveforms.

SHIFT

SHIFT is a single-waveform/image operator that shifts the waveforms or sets the zero coordinates of an image according to the cursor or an entered value. For cursor inputs, the cursor location becomes the new location of time zero for waveforms or the x-y axis zero coordinates for images. For entered inputs the values are added to the starting time of the waveform or the current coordinate system. This command modifies all of the selected waveforms. In command mode, one or two inputs will be required depending on the mode. If the initialization keyword NOSHIFTBYCURSOR is selected, only numeric inputs will be accepted.

BASELINE

BASELINE is a single-waveform/image operator that “baselines” the waveforms or images according to the cursor or an entered value. The cursor or entered input defines a time for waveforms or an area for images over which the integral of all the selected waveforms is set to zero. Thus, offset before the main pulse can be removed from the overall integral of waveforms or background noise set to zero for images. This command modifies all of the selected waveforms/images.

COMPARE

COMPARE is a multiple-waveform operator that compares two waveforms. This command *must* have the reference waveform selected and ENTERed. Then the variable waveform to be compared to the reference is selected and the COMPARE button is pressed. A copy of the variable waveform is used for all operations so the original is not modified. First, the two waveforms are resampled to the same time intervals. Then a cross-correlation operation is performed to find the optimum time shift to best time align the two waveforms and the variable waveform/image is time shifted and truncated to completely overlap the reference waveform. Finally, an IDL polynomial fitting routine is used to fit the equation:

$$\text{REFERENCE} = \text{SCALE}*\text{VARIABLE} + \text{OFFSET}. \qquad \textbf{(EQ 1)}$$

Here, the scale is the multiplier that should be applied to the variable waveform to best fit it to the reference waveform and the offset is the constant that must be added to it. There are two possible modes for the COMPARE operation: BASELINE FIXED and BASELINE VARIABLE. If the fixed mode is chosen, then the offset is zero. The reference waveform and the best fit variable waveform are plotted with the scale, offset, time shift, standard deviation, and correlation coefficient of the fit shown on the left side of the graphics area. The fitting parameters are stored in registers that can be used as input for subsequent operations according to the following scheme.

TABLE 5. Register Names and Contents from COMPARE Operation

Register Name	Quantity
#SCALE	Scale factor
#OFFSET	Baseline offset
#XSHIFT	Time shift
#RSQRD	R^2 correlation value

After the compare operation is complete, you can press the PRINT button to generate a hardcopy or press the ZOOM button to zoom in on the compared plot (and print this if you desire).

NORMALIZE

NORMALIZE is a single-waveform/image operator that divides each selected waveform/image by the absolute value of its peak value thus maintaining the polarity. This command modifies all of the selected images/waveforms which will then range from -1 to 1.

INTEGRATE

INTEGRATE is a single-waveform/image operator that integrates the waveforms point by point using Simpson's rule. A new waveform is created for each one integrated if sufficient waveform memory is available; otherwise, the old waveforms are overwritten. These new waveforms are named the same as the original waveforms except the names are prefixed with "INT_". This command does not modify any of the waveforms if sufficient memory exists. For images, two new waveforms are created, one being the x-integral and one being the y-integral. Integrating either of these waveforms gives the total integral over the image.

DIFFERENTIATE

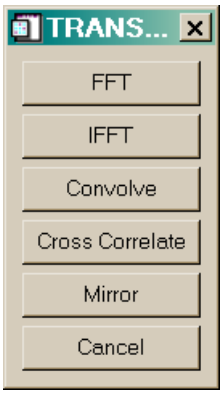
DIFFERENTIATE is a single-waveform operator that differentiates the waveforms point by point using a three-point central differencing technique. A new waveform is created for each one differentiated if sufficient waveform memory is available; otherwise, the old waveforms are overwritten. These new waveforms are named the same as the original waveforms except the names are prefixed with "DIF_". This command does not modify any of the waveforms if sufficient memory exists. Differentiate is undefined for images but see the Filter commands for edge enhancement routines.

TRANSFORMS

The TRANSFORMS button pops a window (Fig. 6) with all available transforms accessed by buttons. The window that is created depends on the mode, image or waveform, because different transforms are appropriate in the different modes. For waveforms the routines FFT, IFFT, CONVOLVE, and CROSS CORRELATE are provided. For images, the routines ROTATE, MIRROR (about 4 different axes), and UNWRAP are available. The command mode operation is a bit different for these operators because an additional level of widgets exists. The following sequence would work for FFT with similar sequences for the others.

Command Equivalent
WAVEFORM.name
TRANSFORMS
FFT

FIGURE 6. Waveform TRANSFORMS subwindow



FFT

FFT is a single-waveform operator that takes the discrete Fourier transform of the selected waveforms. It returns complex waveforms, so for each waveform with name “DATA” three new waveforms (“RE_FFT_DATA”, “IM_FFT_DATA”, and “MAG_FFT_DATA”) are created. The first waveform contains the real component, the second contains the imaginary component, and the third contains the magnitude of the FFT. Time-phase information is lost during this process because it cannot be easily removed from the inverse operation IFFT. Therefore, if you transform a waveform and then invert the transform you will recover the shape but the waveform will start at t=0. FFT results are displayed from the negative Nyquist frequency to the positive Nyquist frequency. If the original waveform has an even number of points, one point is removed in the FFT so that the dc component will fall at 0 Hz on the plot.

IFFT

IFFT is a multiple-waveform operator that takes the inverse discrete Fourier transform of the selected waveforms. The real component must be designated with the ENTER button, followed by selecting the imaginary component. This operation returns complex waveforms, so for each waveform “DATA” two new waveforms (“RE_IFFT_DATA” and “IM_IFFT_DATA”) are created. The first waveform contains the real component and the second contains the imaginary component of the IFFT. Time-phase information is lost during this process. Therefore, if you transform a waveform and then invert the transform you will recover the shape but the waveform will start at t=0. A typical command sequence is shown below.

Command Equivalent
WAVEFORM.RE_Waveform
ENTER
WAVEFORM.IM_Waveform
TRANSFORMS
IFFT

CONVOLVE

CONVOLVE is a multiple-waveform operator that performs the mathematical convolution operation by serial addition (rather than an FFT/IFFT pair). The first waveform must be ENTERed even though the operation is commutative. A new waveform, containing the convolution of the two will be created with its name based on the ENTERed waveform name prefixed with “CONV_”. The new waveform is longer than either original waveform.

CROSS CORRELATE

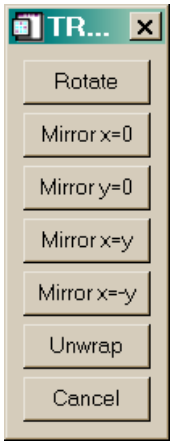
CROSS CORRELATE is a multiple-waveform operator that performs a cross correlation by serial addition (rather than an FFT/IFFT pair). The first waveform must be ENTERed because this operation is not commutative. A new waveform, containing the cross correlation of the two will be created with its name based on the ENTERed waveform name prefixed with “XCOR_”. The new waveform is longer than either original waveform.

MIRROR

MIRROR is a single-waveform operator that reverses the waveforms about zero time. This command modifies all of the selected waveforms

Command Equivalent
TRANSFORMS MIRROR

FIGURE 7. Image TRANSFORMS window



ROTATE

ROTATE is a single-image operator that will rotate an image about the point defined by the x=0, y=0 by an arbitrary angle. You are prompted for the angle to rotate the image by in a *clockwise* sense. The image is modified and undefined areas of the rotated image are filled with zeros.

Command Equivalent
TRANSFORMS ROTATE <CW rotation angle>

MIRROR X=0
MIRROR Y=0
MIRROR X=Y
MIRROR X=-Y

MIRROR X=0, MIRROR Y=0, MIRROR X=Y, and MIRROR X=-Y are single-image operators that reflect the image about the x=0 (y-axis), y=0 (x-axis), x=y diagonal, or x=-y diagonal, respectively. The image is modified.

Command Equivalent
TRANSFORMS MIRROR X=0 or MIRROR Y=0 or MIRROR X=Y or MIRROR X=-Y

UNWRAP

UNWRAP is a single-image operator that assumes that the digitized image was originally wrapped around a cylinder with axis along the y-axis of the cylinder. You are

prompted for the cylinder radius. UNWRAP then corrects the x-axis units to account for unwrapping the film to digitize it. The image is modified.

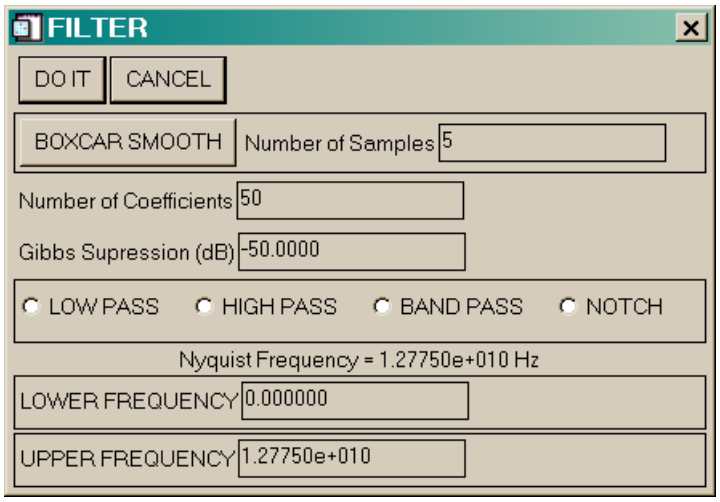
Command Equivalent

```
TRANSFORMS
UNWRAP
<cylinder radius>
```

FILTERS

As with TRANSFORMS, the FILTERS operation provides mode sensitive sub-windows. In waveform mode, the waveform FILTERS window appears while in image mode, the image FILTERS window appears.

FIGURE 8. Waveform FILTERS input window

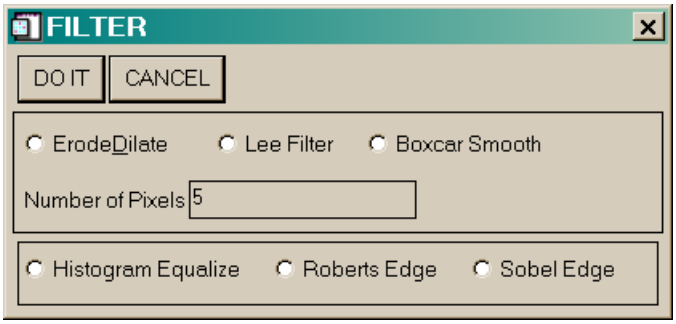


The waveform FILTERS operator is a multiple-waveform operator that performs low-pass, high-pass, band-pass and notch filtering. The maximum filtering frequency depends on the waveform with the largest sampling interval of those selected. The FILTERS button pops a widget (Fig. 8) to obtain information about the desired filter and the filter frequencies desired. The original waveforms are overwritten. The filter algorithm uses a non-recursive digital filter with 50 coefficients and a 50dB Gibbs peak roll off obtained from a Kaiser windowing function. The number of coefficients and the Gibbs roll off are variable. For notch filters in the command equivalent, simply set f_{lower} greater than f_{upper}. These frequencies are in Hz in the command file. The Gibbs suppression number controls a Kaiser window. For very steep filters, set this number near 0dB. Register inputs are allowed in the command mode.

Command Equivalent

```
FILTERS,
<lower frequency (Hz)>
<upper frequency (Hz)>
<# Coefficients>
<Gibbs roll off (dB)>
```

FIGURE 9. Image FILTERS Window



ERODE&DILATE

The ERODE&DILATE image filter performs erosion followed by dilation back to the original image size. The number of pixels is used to create a square operator. The net effect of this filter is to remove all structure in the image smaller than the size of the square operator. Thus, if a 5 pixel argument is provided, all features smaller than 5x5 pixels will be lost. The image is modified.

Command Equivalent
FILTERS ERODE&DILATE <number of pixels>

LEE FILTER

The LEE FILTER performs the Lee filter algorithm on the image using a box of size NxN pixels where N is odd. If an even N is input, then the next smaller odd number will be used. The image is modified. The Lee filter algorithm (see IDL Reference Guide) smooths additive image noise by generating statistics in a local neighborhood and comparing them to the expected values.

Command Equivalent
FILTERS LEE FILTER <number of pixels>

BOXCAR SMOOTH

The BOXCAR SMOOTH filter performs simple boxcar smoothing on the image using a box of size NxN pixels (see IDL Reference Guide). If an even N is input, then the next larger odd number will be used. The image is modified.

Command Equivalent
FILTERS BOXCAR SMOOTH <number of pixels>

HISTOGRAM EQUALIZE

The HISTOGRAM EQUALIZE operator performs histogram equalization of the image (see IDL Reference Guide). The resulting image will maintain the existing peak value.

Command Equivalent
FILTERS HISTOGRAM EQUALIZE

ROBERTS EDGE

The ROBERTS EDGE filter performs Roberts edge enhancement, a linear edge sharpening and isolation algorithm (see IDL Reference Guide), on the image.

Command Equivalent
FILTERS
ROBERTS EDGE

SOBEL EDGE

The SOBEL EDGE filter performs Sobel edge enhancement using a nonlinear edge enhancement operator (see IDL Reference Guide).

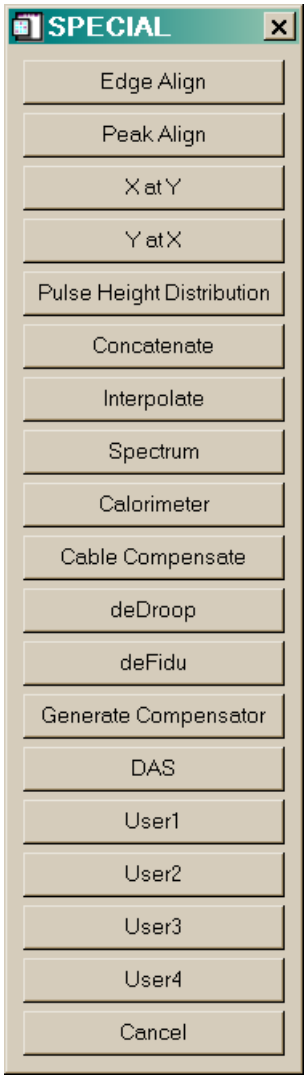
Command Equivalent
FILTERS
SOBEL EDGE

SPECIAL (Waveform)

Many additional operations that are infrequently used or did not fit under any other category are grouped under the SPECIAL button. For instance, waveform cable compensation and various image profiling procedures are The command mode operation is a bit different for these operators because an additional level of widgets exists. The following sequence would work for MIRROR with similar sequences for the others.

Command Equivalent
WAVEFORM.name
SPECIAL
MIRROR

FIGURE 10. Waveform SPECIAL selection window



EDGE ALIGN

EDGE ALIGN is a multiple-waveform/ operator that time aligns all waveforms with the ENTERed waveform/image based on an input fraction of the peak value of each wave-

form. The user is prompted for this fraction so in automatic execution mode, a fraction between-1 and 1 is needed. For positive fractions, the alignment is done according to the peak value of the waveform. For negative fractions, the alignment uses the opposite polarity compared to the peak value of the waveforms. The numerical argument may be a register.

Command Equivalent
SPECIAL EDGE ALIGN <number>

PEAK ALIGN

PEAK ALIGN is a multiple-waveform/ operator that time aligns the selected waveforms using the cross-correlation algorithm of the COMPARE routine. This command modifies all of the selected waveforms except the ENTERed reference waveform.

Command Equivalent
SPECIAL PEAK ALIGN

Y at X

The Y at X command is a single waveform operator that places the value of the last waveform selected at the x value entered from the keyboard (the cursor cannot be used). This command does not operate on images. It loads the #YATX register for further manipulations.

Command Equivalent
SPECIAL Y at X <x value>

X at Y

The X at Y command is a single waveform operator that places up to 4 x values corresponding to the input y value entered at the keyboard (the cursor cannot be used). It operates only on the last waveform selected and not on images. The registers #XATY1, #XATY2, #XATY3,. and #XATY4 are loaded with the crossing values. If no crossing is found, -1e36 is placed in the registers.

Command Equivalent
SPECIAL X at Y <y value>

PULSE HEIGHT DISTRIBUTION

The PULSE HEIGHT DISTRIBUTION (PHD) command is a single waveform operator that calculates the pulse height distribution for the selected waveforms. You are prompted for a number of bins to use to create the PHD. The new x-axis has this number of bins and has the units of the selected waveform's y-axis. The y-values are the number of elements of the original waveform in each bin. Essentially, this provides a histogram of the data.

Command Equivalent
SPECIAL PULSE HEIGHT DISTRIUTION <number of bins>

CONCATENATE

CONCATENATE is a dual-waveform operator to paste two waveforms together. A time is defined using either the cursor or a numeric time input, depending on the cursor preference. The late time portion of the second waveform is appended to the early-time portion of the entered waveform. The entered waveform is overwritten.

Command Equivalent
SPECIAL
CONCATENATE

INTERPOLATE

INTERPOLATE is a single-waveform operator that allows you to change a section of a waveform to the values linearly interpolated between two defined times. In cursor mode, a box to define the times appears and in non-cursor mode, you are prompted for the two times. The box may be moved by pressing and holding the left mouse button, resized by pressing and holding the middle mouse button (or control-left button), and exited by pressing the right mouse button. (Mac users will need to use special keys with the single mouse key to perform these acts - see the ZOOM command on page 68.) This command modifies all of the selected waveforms. In command mode, the two times must be entered on separate lines and may contain register references.

Command Equivalent
SPECIAL
INTERPOLATE
<tmin>
<tmax>

SPECTRUM

SPECTRUM is a dual-waveform operator to calculate the electron spectrum given the voltage and current waveforms in a diode. You must select the voltage waveform and ENTER it followed by the current waveform. The procedure assumes that these two waveforms are properly time aligned. Then you are prompted for the number of spectral bins and the desired maximum energy. If the voltage or current are negative polarity, they are converted to positive polarity so the maximum spectral energy is always positive. SPECTRUM creates two new pseudo-waveforms, ESPECTRUM and CUMSPECTRUM. ESPECTRUM contains the differential electron number spectrum, normalized to an integral of one electron. The CUMSPECTRUM pseudo-waveform contains the cumulative number spectrum integral of ESPECTRUM, normalized to unity. The standard INTEGRATE command is not proper because of some tricks used in the binning of the electron spectrum to make the ESPECTRUM histogram look nice. The bottom bin begins at $\Delta E_{bin}/2$ and will have the number of particles with energies between 0 and ΔE_{bin}. All other bin widths are ΔE_{bin}. The peak bin ends at the maximum energy plus $\Delta E_{bin}/2$. For CUMSPECTRUM, the bottom bin begins at 0.0 and the top bin ends at the maximum energy. Note that any waveform with SPECTRUM in the name will be plotted as a histogram. The original two waveforms are not altered by this process. If you repeat the operation, the existing ESPECTRUM and CUMSPECTRUM waveforms will be overwritten unless you rename them.

Command Equivalent
WAVEFORM.V
WAVEFORM.I
SPECIAL
SPECTRUM
<nbins>
<maximum energy>

CALORIMETER

CALORIMETER is a single-waveform operator that calculates the value of the selected waveform at the time t=0 by linear extrapolation. The peak of the waveform is used as one point and the second is determined by the cursor or a delta time can be entered in an input box if the cursor preference is off.

Command Equivalent
SPECIAL CALORIMETER

CABLE COMPENSATE

CABLE COMPENSATE is a multiple-waveform operator that performs the mathematical convolution operation by serial addition of a response waveform with a cable compensator waveform. The first waveform must be ENTERed and then the cable compensator selected. The original waveform is overwritten and is not lengthened.

DEDROOP

DEDROOP is a single-waveform operator that removes an RC type roll off from a set of waveforms. This is done by serial convolution with a correction waveform. The original waveforms are overwritten.

Command Equivalent
SPECIAL DEDROOP <RC time in s>

DEFIDU

DEFIDU is a single-waveform operator that removes a positive fiducial marker from a set of waveforms. If the cursor preference is on, a cursor appears to define the portion of the waveform containing the fiducial marker. Otherwise, it is assumed that the fiducial marker is within the first 10% of the waveform. The peak of the fiducial is assumed to define time zero and the waveform is deleted up to the point at which the fiducial drops to 10% of its peak plus three points. The original waveforms are overwritten.

GENERATE COMPENSATOR

GENERATE COMPENSATOR is a multiple-waveform operator that performs the mathematical deconvolution operation to find the cable compensator waveform. The reference waveform (directly into the digitizer) must be ENTERed and then data with the cable in place is selected. Next you are prompted for the truncation fraction (0.5 is a good start) and the desired length of the compensator array. The desired length defaults to a multiple of 500 but may need to be a power of two for some digitizers. This operation performs the serial deconvolution operation described in Boyer's report SAND87-3072. The cable compensator is given the name of the second waveform prefixed by "COMP_". The reference data, cable data, and compensated cable data are then plotted. If you repeat the operation with a different truncation fraction, then the compensator waveform is overwritten.

DAS

The DAS command activates software to reduce a set of 10 waveforms in a Differential Absorption Spectrometer. The waveforms must be selected in the order from the least filtered member to the most heavily filtered member. Then you are prompted for the desired number of time slices and the accelerator used. Currently, Saturn, SPHINX, and Pithon spectra are supported by this command. The YOGI algorithm then estimates the photon spectrum at each time slice by performing an under determined unfold. For further information, consult the Sandia report on the DAS.

SPECIAL (Image)

The SPECIAL selection brings up a different set of choices if you are in Image mode instead of Waveform mode. Fig. 11 shows the possible choices which are further described below.

FIGURE 11. Image SPECIAL selection window

LINE PROFILE

LINE PROFILE uses a line cursor or four inputs to define a line in the image. A new waveform is created containing the profile of the image along this line.

RHO PROFILE

RHO PROFILE performs averaging of line profiles along a number of radii of a circle. You can select the number of averages and the starting and ending angles. With the cursor preference on, RHO PROFILE uses an input box to define the starting angle, ending angle, and number of radii followed by three cursor points to define a circle. With the cursor preference off, you are prompted for the coordinates of the center of the circle, the radius of the circle, the starting and ending angles, and the number of radii to average over. Profiles are generated along the radii and averaged together to create a new waveform named <RHO>_PROFILE containing an averaged profile. The command equivalent with cursor preference off is shown below.

Command Equivalent
SPECIAL
RHO PROFILE
<x coordinate of center>
<y coordinate of center>
<circle radius>
<start angle in degrees>
<end angle in degrees>
<number of radii>

X-Y PROFILE

X-Y PROFILE uses the box cursor or four inputs to define a sub area of the image to create both x and y profiles for. Two new waveforms are created that have the average profile along the x and y directions.

CENTER

The CENTER algorithm allows you to define three points on the circumference of a circle using the cursor. The center of this circle is then redefined as the center of the image. This command requires the use of the cursor to define the circle.

FILM2484

The FILM2484 algorithm converts optical density (OD) for an image to energy fluence (F in ergs/cm^2) assuming that type 2484 film has been used. The correction algorithm is F = 0.0002*exp(0.3687*OD).

Command Equivalent
SPECIAL
FILM2484

USER1
USER2
USER3
USER4

USER1 through USER4 are distributed as template procedures that every user can modify easily to create their own operators. USER1 and USER2 are designed as single waveform operators while USER3 and USER4 are designed as dual waveform operators. To create your own procedures, copy the **XI_user.pro** file from the *xdamp* library location to your local directory. Edit the file appropriately, but do not change the names of the operators from USERN to something else. When you run *xdamp*, your own routine will be compiled and executed when these buttons are pushed. The distribution file has sufficient boiler plate information to show how to construct an operator. Knowledge of IDL programming language is assumed.

These do not work if you have the run-time licensed version.

Speed Buttons

A series of speed buttons are placed immediately above the waveform button area and just below the operator area. These are for the most commonly used tasks and some of the buttons are also available from the menus.

WAVEFORM/IMAGE

The WAVEFORM and IMAGE toggle buttons serve as another way to change display modes. The button shows the current status. Pressing it changes to the other mode. In command mode, WAVEFORM will change to the waveform view and plot any selected waveforms. Similarly IMAGE will change to the image view and plot any selected waveforms. The command IWTOGGLE will switch you from whatever mode you are in to the other mode.

Command Equivalent	
WAVEFORM	forces WAVEFORM mode
IMAGE	forces IMAGE mode
IWTOGGLE	switches to other mode

ENTER

The ENTER button is used to designate one waveform as special. For operations adding, subtracting, multiplying, or dividing two waveforms, the ENTER button designates the waveform to be overwritten. It is best thought of as a reverse Polish notation (RPN) style ENTER button. For operations that use one waveform as a reference (i.e. COMPARE or cable compensator creation) the ENTER button designates the reference waveform.

CLEAR

The CLEAR button deselects all waveforms, clears the plot area, and clears the message box.

Command Equivalent
CLEAR

SELECT

The SELECT button selects waveforms based on an input string containing wildcard characters (*) in the specification. For instance V* would select all waveforms beginning with the capital letter V. The string specification is case sensitive.

Command Equivalent
SELECT <wildcard selection string>

ALL

The ALL button selects all of the waveforms.

Command Equivalent
ALL

PRINT SCREEN

The PRINT SCREEN button causes whatever is in the current plot window to be placed in a print file. This is also accessible via the PRINT menu as PRINT.SCREEN. The print file is not spooled until you exit the program or force a spool through the PRINT menu.

Command Equivalent
PRINT SCREEN

PLOT

The PLOT button causes all waveforms selected to be immediately plotted. If no waveforms have been selected, then all the waveforms are plotted sequentially with a two second delay.

Command Equivalent
PLOT

ZOOM

The ZOOM button replots the selected waveforms and places a zoom box on the screen if the cursor preference is on. The zoom box may be moved by pressing and holding the left mouse button, resized by pressing and holding the middle mouse button or control-left button, and exited by pressing the right mouse button. (Mac users will need to use special keys with the single mouse key to perform these acts and Windows users should have a three-button mouse or use control-left button to emulate the middle button.) The zoomed image is then plotted. If the cursor preference is off, you are prompted for the four limits of the zoom plot. In the command equivalent, the last four inputs are only needed if you are not in cursor mode. You may use register inputs in this case. Note that older versions of *xdamp* placed all four numbers on one line, separated by commas. Now each number must be on a separate line. Note that if you have reversed the color table, the zoom box will become invisible.

Command Equivalent
ZOOM <tmin or xmin in data units> <tmax or xmax in data units> <ymin in data units> <ymax in data units>

CURSOR

The CURSOR button allow you to move the cursor on the screen and observe values in the message window. When you click on the left mouse, the current cursor values are loaded in the registers CURSORX, CURSORY and CURSORZ if you are in image mode. You may then perform register operations using these values. This command ignores the cursor preference and always places a cursor on the screen, even in automatic execution mode where it is effectively interactive.

Command Equivalent
CURSOR

H BARS

The H BARS button creates two horizontal cursor bars for use in loading registers with measurement data from waveforms. The cursors are moved as a pair with the left mouse button, individually with the middle mouse button or control-left button and the right mouse button ends movement. The x,y values based on the last waveform plotted for the cursors are loaded into the registers #CURSORX, #CURSORY, #CURSORX2, and #CURSORY2, while the delta values are placed in #CURSORDX and #CURSORDY.

Command Equivalent
H BARS

V BARS

The V BARS button creates two vertical cursor bars for use in loading registers with measurement data from waveforms. The cursors are moved as a pair with the left mouse button, individually with the middle mouse button or control-left button and the right mouse button ends movement. The x,y values based on the last waveform plotted for the

cursors are loaded into the registers #CURSORX, #CURSORY, #CURSORX2, and #CURSORY2, while the delta values are placed in #CURSORDX and #CURSORDY.

Command Equivalent
V BARS

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Waveform/Image Buttons

The names of the waveform/image buttons vary with the application. The technique used to select any waveform is identical; simply push the button. To deselect a waveform, simply push the button again. The command syntax is shown below for a waveform named Example. Note that the names are case sensitive.

Command Equivalent
WAVEFORM.Example

To select an image, simply use a similar command with IMAGE replacing WAVEFORM.

If too many waveforms exist to fit in the waveform button box, then the box becomes a scrolling region and you may need to use the scroll bars to find the waveforms to select.

Beware of two things. The waveform selection process is a toggle that may cause problems in automatic execution mode if a waveform is selected for a second time and becomes deselected. Also, waveform names are case sensitive.

In command mode, three methods are available for changing modes. First, you can simply select an image or waveform to switch modes. Second you can use WAVEFORM or IMAGE to force the particular mode. Third, you can use IWTOGGLE to change modes.

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Problems and Troubleshooting

If you experience a problem, *first* look in the message area for an informational message about anything that may be illegal such as performing an operation that requires an ENTER or opening a file with the incorrect format. Next, look in the IDL command window area for error messages that might indicate problems with memory or a corrupted xdamp module.

If you can't get *xdamp* to start properly on a DOS computer, be certain that the file IDLSPAWN.PIF has been moved to the windows subdirectory and edited to be exclusive. (This is not necessary on Windows 95 or Windows NT computers.)

If your display does not appear similar to Figure 1, "xdamp screen layout in waveform mode," on page 17, then you probably need to change the widget font size in your **.Xdefaults** file (See "GETTING STARTED" on page 13.) and then reboot on a Unix system. PC users can use the Wfont=SYSTEM*12 (for instance) command in the **xdamp.ini** file and Macintosh computers can adjust this font size in the IDL preferences menus. If this doesn't work, reduce the size of the graphics font area according to your display's limitations by using the GRAPHIC AREA command in the **xdamp.ini** file or in the OPTIONS screen.

If you have trouble when opening a file, you may need to edit the **XIsys_sp.pro** file and increase the maximum length of allowable waveforms or create an **xdamp.ini** file that modifies these limits. For efficiency, be sure that this length is not appreciably longer than necessary for your longest record. You can use TOOLS/LIMITS to see what the current values are.

If *xdamp* fails when you first try to plot a waveform, then you probably have an illegal font name in your **xdamp.ini** file. Remove the GFONT=font_string line from this file and try *xdamp* again.

Difficulties with the Unix file selection widget are usually due to rapid multiple clicking on selections. This widget wants *single* clicks (on Unix systems) and is not particularly fast because it must spawn system commands to obtain the directory information. Be patient. The file selection widget is also case sensitive.

A common difficulty is not recognizing that waveform names *are* case sensitive when defining a select string with wild cards. Similarly, the file filter definition must contain an asterisk like *.hdf and the file names are also case sensitive. *Without a wild card, nothing will be selected.*

The single file automatic execution mode does not initialize many variables (for maximum flexibility). Therefore, you should start your macro file assuming that the waveform selection state is ill-defined. However, multiple file automatic execution reinitializes based on your **xdamp.ini** file for each new file opened.

When using automatically loaded registers, remember that the pulse parameter values come from the last waveform selected, not the first waveform selected. When in doubt,

just plot one waveform at a time. The pulse parameters are generated whether or not you elect to have the results displayed on the screen.

The xfont widget application is not very robust. Frequently, it will have conflicts if another application (FrameMaker) is using display PostScript. It is best to set the font by using this widget *immediately* after starting only IDL, reading the font in the message window and placing this in the **xdamp.ini** file with the GFONT=font_string command.

Color table problems can occur in this application. A specific symptom is if the zoom box is not visible. Other applications and IDL can use the same color map, not always with benign interactions. For Unix systems, use the Idl.colors: 64 command in your **.Xdefaults** file to reserve some colors to IDL. PC and Mac systems seem to operate best if only 256 colors are enabled for the display. For other systems, the order in which applications are started can affect what happens.

If you have insufficient memory failures while deleting or keeping waveforms, edit the **XI_edit.pro** file and find the **XIedit_delete** section. There is a comment with a note to uncomment one line and comment out another line to improve the memory management at the expense of speed. Do the same thing with the **XIedit_keep** section. This will slow the delete and keep commands but generally prevents insufficient memory failures.

In automatic execution mode, if you are automatically clearing the stack after each operation and are using a journal file generated with this setting disabled, very strange things can occur. Many of the operators are overloaded and think that trying to add without any waveform selected means that you want to add a constant to a register. When there is no valid information for the register arithmetic, the whole automatic execution will fail. This cannot be trapped easily so you must generate command files with the stack clearing preference you will use when executing them.

Do not end a macro file with a comment or blank line. *xdamp* thinks another command follows this and fails when it reaches the end of file unexpectedly.

Do not use FILE.GET DATA to append files with only a single array. Instead use the FILE.APPEND which is faster and requires less input from the user.

Macintosh Specific Issues

If your display does not appear like Figure 1, “xdamp screen layout in waveform mode,” on page 17, then you probably need to reduce the widget font size via the preferences section. If this doesn’t work, then reduce the size of the graphics font area in the file **XIsys_sp.pro** or with the GRAPHIC AREA command in the **xdamp.ini** file according to your display’s limitations.

Do not use the close window box to complete data entries. Use the DONE button in the widget instead. Otherwise, IDL will not receive an event to process the input stream.

Macintosh output cannot be automatically spooled. You must print the **xdamp.out** file yourself after performing a PRINT.QUEUE command. This can be done using the shareware program DropPs available from mac.archive.umich.edu via anonymous ftp.

Macintosh journal file output will appear on a single line if you are using the Power PC version. Using an editor, change all the linefeeds (ASCII 10) to carriage returns and continue to edit the file normally. This is a known IDL bug.

To use the ZOOM, you need three mouse buttons. The left button is the normal Mac button, the center button is the Option key with the mouse button and the right button is the Apple key with the mouse button.

The Xfont application does not function for Macintosh computers. Instead, use the preferences section of the Macintosh menu bar to set the desired font for the application.

On a Macintosh, DO NOT use the FILE.QUIT on the screen menu bar because this will not properly close the journal file.

Windows Specific Issues

After some operations, you sometimes wind up back at the main IDL window instead of at the *xdamp* window. Use CONTROL-TAB to switch back to the desired window.

If you don't have a PostScript printer and want to print the **manual.ps** file, download the Ghostscript, Ghostview, GSview freeware from:

http://www.cs.wisc.edu/~ghost/index.html

and install it on your system. Alternatively, you can use Adobe Acrobat Reader 3.0 to read the **manual.pdf** file. The free Acrobat Reader is available at:

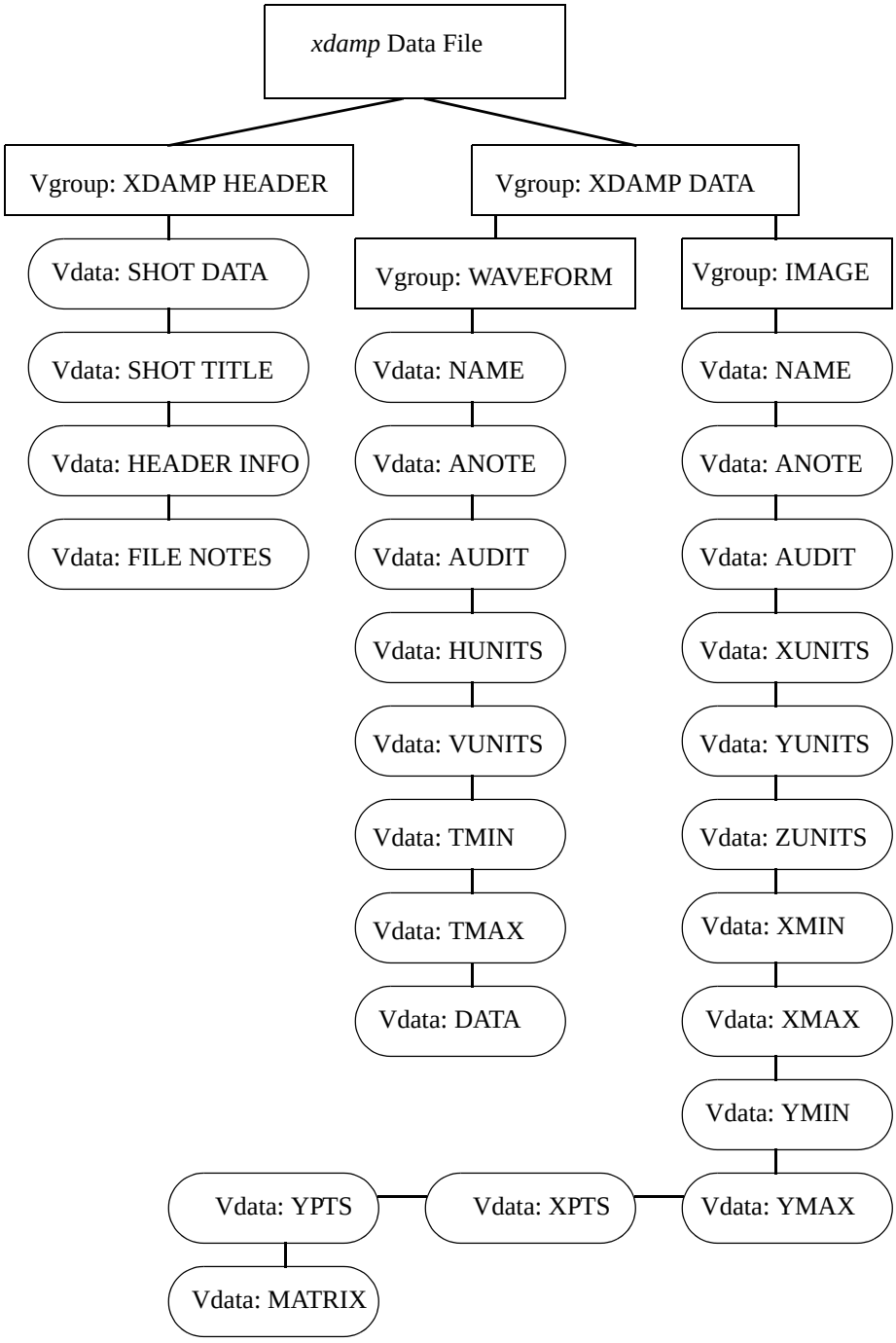
http://www.adobe.com/

To use zoom, you need a three button mouse and appropriate mouse driver software or you can emulate the middle button with control-left button. So far, Mouse Systems and Logitech mice have been tested and work, without bothering with the driver.

If you are having difficulty with *xdamp* recognizing the **xdamp.ini** file, check the default working directory in any shortcut you are using. *xdamp* will look in this default file folder for the **xdamp.ini** file. Runtime users note that only the **xdamp.ini** file in the xdamp\bin\bin.x86 (or similar) directory will be read.

HDF Data File Organization

Vgroup and Vdata structure for *xdamp* HDF file format with field names.



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HDF read and write IDL procedures

READ HDF FILE PROCEDURE

```
;+
; Copyright (c) 1998, Sandia Corporation. The United States Government
; retains a nonexclusive license in this software as prescribed in
; AL 88-1 and AL 91-7. Export of this program may require a license from
; the United States Government.
;+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
;  procedure XI_readfile, filename, append keyword, overwrite keyword,
;      getarray keyword
;
;  Internal routine that opens the file, reads the data from HDF and loads
;  the data common block.
;-----------------------------------------------------------------------------
PRO XI_readfile, fname, APPEND = append, OVERWRITE = overwrite, $
            GETARRAY = getarray

@XI_bases.cmn
@XI_data.cmn
@XI_jrnl.cmn
@XI_stack.cmn

XI_print, “Reading “+fname

IF KEYWORD_SET(OVERWRITE) THEN over = 1 ELSE over = 0
IF KEYWORD_SET(APPEND) THEN appnd = 1 ELSE appnd = 0
IF KEYWORD_SET(GETARRAY) THEN geta = 1 ELSE geta = 0

;*** figure out the prepend string
str = XIfile_pre(fname)
IF (geta OR over OR nfiles EQ 1) THEN str = ““
IF (auto_flag AND NOT over AND NOT appnd AND NOT geta) THEN str = ““

;*** loop through the file reading the information and saving it
IF (narrays EQ 0) THEN i=1 ELSE i=narrays+1
IF (nimages EQ 0) THEN ii=1 ELSE ii=nimages+1

IF (over + appnd + geta EQ 0) THEN BEGIN
  shot_title = “ “
  shot_date = “ “
ENDIF
anote = “ “
audit = “ “
npts = 0L
s_buffer =  “abcdefghijklmnopqrstuvwxyabcdefghijklmnopqrstuvwxy”+ $
        “abcdefghijklmnopqrstuvwxyabcdefghijklmnopqrstuvwxy”+ $
        “abcdefghijklmnopqrstuvwxyacdefgh”

;*** HDF FORMAT
```

```
IF (HDF_ISHDF(fname)) THEN BEGIN
hdf_handle = HDF_OPEN(fname, /READ)

;*** be sure not an image file incorrectly selected
  IF (HDF_DFR8_NIMAGES(fname) GT 0) THEN BEGIN
    XI_print, fname+" is an image file."
    HDF_CLOSE, hdf_handle
    RETURN
  ENDIF

;*** find header Vgroup
  vgxh = -1
  REPEAT BEGIN
    t = vgxh
    vgxh = HDF_VG_GETID(hdf_handle, t)
    vid = HDF_VG_ATTACH(hdf_handle, vgxh, /READ)
    HDF_VG_GETINFO, vid, NAME=tname
    HDF_VG_DETACH, vid
  ENDREP UNTIL (tname EQ "XDAMP HEADER" OR vgxh EQ -1)
  IF (vgxh NE -1) THEN BEGIN
    vgxhh = HDF_VG_ATTACH(hdf_handle, vgxh, /READ)

;*** find shot information Vgroup
    vgxi = -1
    inote = 0
    ihead = 0
    REPEAT BEGIN
      t = vgxi
      vgxi = HDF_VG_GETNEXT(vgxhh, t)
      IF (HDF_VG_ISVD(vgxhh, vgxi)) THEN BEGIN
        vid = HDF_VD_ATTACH(hdf_handle, vgxi, /READ)
        HDF_VD_GET, vid, FIELDS=tname
        IF (NOT appnd AND NOT geta) THEN BEGIN
        CASE tname OF
       "SHOT DATE":k = HDF_VD_READ(vid,shot_date,FIELDS="SHOT DATE")
       "SHOT TITLE":k=HDF_VD_READ(vid,shot_title,FIELDS="SHOT TITLE")
          "HEADER INFO": BEGIN
                    k = HDF_VD_READ(vid, stg, FIELDS="HEADER INFO")
                    header(ihead) = STRING(stg)
                    ihead = ihead+1
                  ENDCASE
          "FILE NOTES":  BEGIN
                    k = HDF_VD_READ(vid, stg, FIELDS="FILE NOTES")
                    fnotes(inote) = STRING(stg)
                    inote = inote+1
                  ENDCASE
          ELSE:
        ENDCASE
        ENDIF
        HDF_VD_DETACH, vid
```

```
      ENDIF
    ENDREP UNTIL (vgxi EQ -1)
    IF (NOT appnd AND NOT geta) THEN BEGIN
      shot_date = STRING(shot_date)
      shot_title = STRING(shot_title)
    ENDIF
    HDF_VG_DETACH, vgxhh
  ENDIF

;*** find data Vgroup
  vgxd = -1
  REPEAT BEGIN
    t = vgxd
    vgxd = HDF_VG_GETID(hdf_handle, t)
    vid = HDF_VG_ATTACH(hdf_handle, vgxd, /READ)
    HDF_VG_GETINFO, vid, NAME=tname
    HDF_VG_DETACH, vid
  ENDREP UNTIL (tname EQ "XDAMP DATA")
  vgxdh = HDF_VG_ATTACH(hdf_handle, vgxd, /READ)

;*** find wavform or image Vgroup
  vgwd = -1
  REPEAT BEGIN
    t = vgwd
    vgwd = HDF_VG_GETNEXT(vgxdh, t)
    IF (HDF_VG_ISVG(vgxdh, vgwd)) THEN BEGIN
      vid = HDF_VG_ATTACH(hdf_handle, vgwd, /READ)
      HDF_VG_GETINFO, vid, NAME=tname
      HDF_VG_DETACH, vid
    ENDIF
  ENDREP UNTIL (tname EQ "WAVEFORM" or tname EQ "IMAGE")
  vgwdh = HDF_VG_ATTACH(hdf_handle, vgwd, /READ)

;*** now loop through the waveforms or images
  id = -1
  done = 0
  id = HDF_VG_GETNEXT(vgwdh, id)
  REPEAT BEGIN
    flag = 0
    REPEAT BEGIN
      vds = HDF_VD_ATTACH(hdf_handle, id, /READ)
      HDF_VD_GET, vds, FIELDS=testfield
      CASE testfield OF
        "NAME":     k = HDF_VD_READ( vds, aname, FIELDS="NAME")
        "ANOTE":    k = HDF_VD_READ( vds, anote, FIELDS="ANOTE")
        "AUDIT":    k = HDF_VD_READ( vds, audit, FIELDS="AUDIT")
        "HUNITS":   k = HDF_VD_READ( vds, hunit, FIELDS="HUNITS")
        "VUNITS":   k = HDF_VD_READ( vds, vunit, FIELDS="VUNITS")
        "TMIN":     k = HDF_VD_READ( vds, tmin,  FIELDS="TMIN")
        "TMAX":     k = HDF_VD_READ( vds, tmax,  FIELDS="TMAX")
```

```
      "XUNITS":    k = HDF_VD_READ( vds, xunit, FIELDS="XUNITS")
      "YUNITS":    k = HDF_VD_READ( vds, yunit, FIELDS="YUNITS")
      "ZUNITS":    k = HDF_VD_READ( vds, zunit, FIELDS="ZUNITS")
      "XPTS":      k = HDF_VD_READ( vds, xpts,  FIELDS="XPTS")
      "YPTS":      k = HDF_VD_READ( vds, ypts,  FIELDS="YPTS")
      "XMIN":      k = HDF_VD_READ( vds, xmin,  FIELDS="XMIN")
      "XMAX":      k = HDF_VD_READ( vds, xmax,  FIELDS="XMAX")
      "YMIN":      k = HDF_VD_READ( vds, ymin,  FIELDS="YMIN")
      "YMAX":      k = HDF_VD_READ( vds, ymax,  FIELDS="YMAX")
      "DATA":      BEGIN
                     k = HDF_VD_READ( vds, ary, FIELDS="DATA")
                     flag = 1
                   ENDCASE
      "MATRIX":    BEGIN
                     k = HDF_VD_READ( vds, mat, FIELDS="MATRIX")
                     flag = 1
                   ENDCASE
     ELSE:
    ENDCASE
    HDF_VD_DETACH, vds
    id = HDF_VG_GETNEXT(vgwdh, id)
  ENDREP UNTIL flag

  CASE tname OF
    "WAVEFORM":    BEGIN
      dbase(0).name = str+STRING(aname)
      dbase(0).anote = STRING(anote)
      dbase(0).audit = STRING(audit)
   IF (STRLEN(STRCOMPRESS(dbase(0).audit,/REMOVE_ALL))EQ 0) THEN $
        dbase(0).audit = dbase(0).name+":"
      npts = N_ELEMENTS(ary)
      IF (npts GT maxsize) THEN BEGIN
        XI_print, "Data arrays too large, increase maxsize."
        RETURN
      ENDIF
      dbase(0).npts = npts
      dbase(0).xunits = STRING(hunit)
      dbase(0).yunits = STRING(vunit)
      dbase(0).tmin = tmin
      dbase(0).tmax = tmax
      dbase(0).yarray(*) = 0.0
      dbase(0).yarray = ary
      IF (over) THEN BEGIN
        FOR j = 0, next_wstack-1 DO BEGIN
          k = wstack(j)
          IF dbase(k).name EQ dbase(0).name THEN dbase(k) = dbase(0)
        ENDFOR
      ENDIF ELSE BEGIN
        dbase(i) = dbase(0)
        i = i+1
```

```
          IF (i GT maxarrays) THEN BEGIN
            id = -1
            XI_print, “Too many waveforms, increase maxarrays.”
          ENDIF
        ENDELSE
;*** Done with waveforms, may be images to read
        IF (id EQ -1) THEN BEGIN
          HDF_VG_DETACH, vgwdh
          vgwd = -1
          REPEAT BEGIN
            t = vgwd
            vgwd = HDF_VG_GETNEXT(vgxdh, t)
            IF (vgwd NE -1 AND HDF_VG_ISVG(vgxdh, vgwd)) THEN BEGIN
              id = HDF_VG_ATTACH(hdf_handle, vgwd, /READ)
              HDF_VG_GETINFO, id, NAME=tname
              HDF_VG_DETACH, id
            ENDIF
          ENDREP UNTIL (tname EQ “IMAGE” OR id EQ -1 OR vgwd EQ -1)
          IF (vgwd NE -1) THEN BEGIN
            vgwdh = HDF_VG_ATTACH(hdf_handle, vgwd, /READ)
            id = -1
            done = 0
            id = HDF_VG_GETNEXT(vgwdh, id)
          ENDIF ELSE id = vgwd
        ENDIF
      ENDCASE

      “IMAGE”:   BEGIN
        ibase(0).name = str+STRING(aname)
        ibase(0).anote = STRING(anote)
        ibase(0).audit = STRING(audit)
       IF (STRLEN(STRCOMPRESS(ibase(0).audit,/REMOVE_ALL))EQ 0) THEN $
          ibase(0).audit = ibase(0).name+”:”
         IF (xpts GT nxmax OR ypts GT nymax) THEN BEGIN
          XI_print, “Image arrays too large, increase size.”
          RETURN
        ENDIF
        ibase(0).xpts = xpts
        ibase(0).ypts = ypts
        ibase(0).xunits = STRING(xunit)
        ibase(0).yunits = STRING(yunit)
        ibase(0).zunits = STRING(zunit)
        ibase(0).xmin = xmin
        ibase(0).xmax = xmax
        ibase(0).ymin = ymin
        ibase(0).ymax = ymax
        ibase(0).zmat(*) = 0.0
        ibase(0).zmat(0:xpts-1,0:ypts-1) = mat
        IF (over) THEN BEGIN
          FOR j = 0, next_istack-1 DO BEGIN
```

```
            k = istack(j)
            IF ibase(k).name EQ ibase(0).name THEN ibase(k) = ibase(0)
          ENDFOR
        ENDIF ELSE BEGIN
          ibase(ii) = ibase(0)
          ii = ii+1
          IF (ii GT maximages) THEN BEGIN
            id = -1
            XI_print, “Too many images, increase maximages.”
          ENDIF
        ENDELSE
        IF (id EQ -1) THEN HDF_VG_DETACH, vgwdh
      ENDCASE
    ENDCASE
  ENDREP UNTIL (id EQ -1)
  HDF_CLOSE, hdf_handle
ENDIF

IF (NOT over) THEN narrays = i-1 & nimages = ii-1

;*** run through strings, stripping out any exclamation points, they are bad
FOR i = 1, narrays DO BEGIN
  j = STRPOS(dbase(i).name,”!”)
  WHILE (j NE -1) DO BEGIN
    a = dbase(i).name
    STRPUT, a, “|”, j
    dbase(i).name = a
    j = STRPOS(dbase(i).name,”!”)
  ENDWHILE
  j = STRPOS(dbase(i).yunits,”!”)
  WHILE (j NE -1) DO BEGIN
    a = dbase(i).yunits
    STRPUT, a, “|”, j
    dbase(i).yunits=a
    j = STRPOS(dbase(i).yunits,”!”)
  ENDWHILE
  j = STRPOS(dbase(i).xunits,”!”)
  WHILE (j NE -1) DO BEGIN
    a = dbase(i).xunits
    STRPUT, a, “|”, j
    dbase(i).xunits = a
    j = STRPOS(dbase(i).xunits,”!”)
  ENDWHILE
ENDFOR

;*** similarly for images
FOR i = 1, nimages DO BEGIN
  j = STRPOS(ibase(i).name,”!”)
  WHILE (j NE -1) DO BEGIN
    a = ibase(i).name
```

```
    STRPUT, a, “|”, j
    ibase(i).name = a
    j = STRPOS(ibase(i).name,”!”)
  ENDWHILE
  j = STRPOS(ibase(i).zunits,”!”)
  WHILE (j NE -1) DO BEGIN
    a = ibase(i).zunits
    STRPUT, a, “|”, j
    ibase(i).zunits=a
    j = STRPOS(ibase(i).zunits,”!”)
  ENDWHILE
  j = STRPOS(ibase(i).yunits,”!”)
  WHILE (j NE -1) DO BEGIN
    a = ibase(i).yunits
    STRPUT, a, “|”, j
    ibase(i).yunits=a
    j = STRPOS(ibase(i).yunits,”!”)
  ENDWHILE
  j = STRPOS(ibase(i).xunits,”!”)
  WHILE (j NE -1) DO BEGIN
    a = ibase(i).xunits
    STRPUT, a, “|”, j
    ibase(i).xunits = a
    j = STRPOS(ibase(i).xunits,”!”)
  ENDWHILE
ENDFOR

IF (narrays EQ 0 AND nimages EQ 0) THEN XI_print, $
  “Incorrect format or bad data, select another.” $
ELSE BEGIN
  IF (narrays GT 0) THEN XI_print, $
            “Done reading “+STRTRIM(STRING(narrays),2)+” waveforms.”
  IF (nimages GT 0) THEN XI_print, $
            “Done reading “+STRTRIM(STRING(nimages),2)+” images.”
ENDELSE

RETURN
END ;==================== end of XI_readfile routine =================
```

WRITE HDF FILE PROCEDURE

```
;+
; Copyright (c) 1998, Sandia Corporation. The United States Government
; retains a nonexclusive license in this software as prescribed in
; AL 88-1 and AL 91-7. Export of this program may require a license from
; the United States Government.
;+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
;  procedure XI_savefile, filename
;
;  Internal routine that actually writes a file in hdf format
;-----------------------------------------------------------------------------
PRO XI_savefile, new_filename

@XI_data.cmn

;*** declare variables
XI_fields = [“NAME”, “ANOTE”, “AUDIT”, “VUNITS”, “HUNITS”, $
        “TMIN”,  “TMAX”,  “DATA”]
XI_ftype =  [“BYTE”, “BYTE”,  “BYTE”,  “BYTE”,   “BYTE”, $
        “FLOAT”, “FLOAT”, “FLOAT”]
nfields = N_ELEMENTS(XI_fields)

XI_ifields = [“NAME”, “ANOTE”, “AUDIT”, “XUNITS”, “YUNITS”, “ZUNITS”, $
        “XPTS”, “YPTS”, “XMIN”,  “XMAX”,  “YMIN”, “YMAX”, “MATRIX”]
XI_iftype =  [“BYTE”, “BYTE”,  “BYTE”,  “BYTE”,   “BYTE”,   “BYTE”, $
        “INT”, “INT”, “FLOAT”, “FLOAT”, “FLOAT”, “FLOAT”, “MATRIX”]
nifields = N_ELEMENTS(XI_ifields)

s_buffer =  “abcdefghijklmnopqrstuvwxyabcdefghijklmnopqrstuvwxy”+ $
        “abcdefghijklmnopqrstuvwxyabcdefghijklmnopqrstuvwxy”+ $
        “abcdefghijklmnopqrstuvwxyacdefgh”
f_buffer = 1.0

;*** open a new HDF file, get the file handle
hdf_handle = HDF_OPEN(new_filename, /WRITE, /CREATE)

;*** create a vgroup id, attach it and set the name
vg_header = HDF_VG_ATTACH(hdf_handle, -1, /WRITE)
HDF_VG_SETINFO, vg_header, NAME=”XDAMP HEADER”

;*** do another for the data
vg_data = HDF_VG_ATTACH(hdf_handle, -1, /WRITE)
HDF_VG_SETINFO, vg_data, NAME=”XDAMP DATA”

;*** first write shot date and shot title
vds = HDF_VD_ATTACH(hdf_handle, -1, /WRITE)
HDF_VD_FDEFINE, vds, “SHOT DATE”, /BYTE
HDF_VD_WRITE, vds, “SHOT DATE”, STRTRIM(shot_date)
HDF_VD_INSERT, vg_header, vds
HDF_VD_DETACH, vds
vds = HDF_VD_ATTACH(hdf_handle, -1, /WRITE)
```

```
HDF_VD_FDEFINE, vds, “SHOT TITLE”, /BYTE
HDF_VD_WRITE, vds, “SHOT TITLE”, STRTRIM(shot_title)
HDF_VD_INSERT, vg_header, vds
HDF_VD_DETACH, vds

;*** now write in header stuff
FOR i = 0, N_ELEMENTS(header)-1 DO BEGIN
  temp = STRTRIM(header(i))
  IF (STRLEN(temp) GT 0) THEN BEGIN
    vds = HDF_VD_ATTACH(hdf_handle, -1, /WRITE)
    HDF_VD_FDEFINE, vds, “HEADER INFO”, /BYTE
    HDF_VD_WRITE, vds, “HEADER INFO”, temp
    HDF_VD_INSERT, vg_header, vds
    HDF_VD_DETACH, vds
  ENDIF
ENDFOR

;*** now add in the file notes to the header
FOR j = 0, N_ELEMENTS(fnotes)-1 DO BEGIN
  temp = STRTRIM(fnotes(j))
  IF (STRLEN(temp) GT 0) THEN BEGIN
    vds = HDF_VD_ATTACH(hdf_handle, -1, /WRITE)
    HDF_VD_FDEFINE, vds, “FILE NOTES”, /BYTE
    HDF_VD_WRITE, vds, “FILE NOTES”, temp
    HDF_VD_INSERT, vg_header, vds
    HDF_VD_DETACH, vds
  ENDIF
ENDFOR

;*** now add waveforms if any in memory
IF (narrays GT 0) THEN BEGIN
  vg_wvfm = HDF_VG_ATTACH(hdf_handle, -1, /WRITE)
  HDF_VG_SETINFO, vg_wvfm, NAME=”WAVEFORM”

;*** first get a set of vdata ids to put a waveform in
  FOR j = 1, narrays DO BEGIN
    FOR i = 0, nfields-1 DO BEGIN
      vds = HDF_VD_ATTACH(hdf_handle, -1, /WRITE)
      CASE XI_ftype(i) OF
        “BYTE”:    HDF_VD_FDEFINE, vds, XI_fields(i), /BYTE
        “LONG”:    HDF_VD_FDEFINE, vds, XI_fields(i), /LONG
        “FLOAT”:   HDF_VD_FDEFINE, vds, XI_fields(i), /FLOAT
      ENDCASE
      CASE XI_fields(i) OF
        “NAME”:    HDF_VD_WRITE, vds, “NAME”, dbase(j).name
        “ANOTE”:   HDF_VD_WRITE, vds, “ANOTE”, dbase(j).anote
        “AUDIT”:   HDF_VD_WRITE, vds, “AUDIT”, dbase(j).audit
        “HUNITS”:  HDF_VD_WRITE, vds, “HUNITS”, dbase(j).xunits
        “VUNITS”:  HDF_VD_WRITE, vds, “VUNITS”, dbase(j).yunits
        “TMIN”:    HDF_VD_WRITE, vds, “TMIN”, dbase(j).tmin
```

```
        "TMAX":    HDF_VD_WRITE, vds, "TMAX", dbase(j).tmax
        "DATA":    HDF_VD_WRITE, vds, "DATA", $
                dbase(j).yarray(0:dbase(j).npts-1)
        ELSE:
      ENDCASE
      HDF_VG_INSERT, vg_wvfm, vds
      HDF_VD_DETACH, vds
    ENDFOR
  ENDFOR
ENDIF

;*** now build an image description
IF (nimages GT 0) THEN BEGIN
  vg_imag = HDF_VG_ATTACH(hdf_handle, -1, /WRITE)
  HDF_VG_SETINFO, vg_imag, NAME="IMAGE"

  FOR j = 1, nimages DO BEGIN
    FOR i = 0, nifields-1 DO BEGIN
      vds = HDF_VD_ATTACH(hdf_handle, -1, /WRITE)
      CASE XI_iftype(i) OF
        "BYTE":    HDF_VD_FDEFINE, vds, XI_ifields(i), /BYTE
        "INT":     HDF_VD_FDEFINE, vds, XI_ifields(i), /INT
        "LONG":    HDF_VD_FDEFINE, vds, XI_ifields(i), /LONG
        "FLOAT":   HDF_VD_FDEFINE, vds, XI_ifields(i), /FLOAT
        "MATRIX":  HDF_VD_FDEFINE, vds, XI_ifields(i), /FLOAT, $
                ORDER=ibase(j).xpts
      ENDCASE
      CASE XI_ifields(i) OF
        "NAME":    HDF_VD_WRITE, vds, "NAME", ibase(j).name
        "ANOTE":   HDF_VD_WRITE, vds, "ANOTE", ibase(j).anote
        "AUDIT":   HDF_VD_WRITE, vds, "AUDIT", ibase(j).audit
        "XUNITS":  HDF_VD_WRITE, vds, "XUNITS", ibase(j).xunits
        "YUNITS":  HDF_VD_WRITE, vds, "YUNITS", ibase(j).yunits
        "ZUNITS":  HDF_VD_WRITE, vds, "ZUNITS", ibase(j).zunits
        "XPTS":    HDF_VD_WRITE, vds, "XPTS", ibase(j).xpts
        "YPTS":    HDF_VD_WRITE, vds, "YPTS", ibase(j).ypts
        "XMIN":    HDF_VD_WRITE, vds, "XMIN", ibase(j).xmin
        "XMAX":    HDF_VD_WRITE, vds, "XMAX", ibase(j).xmax
        "YMIN":    HDF_VD_WRITE, vds, "YMIN", ibase(j).ymin
        "YMAX":    HDF_VD_WRITE, vds, "YMAX", ibase(j).ymax
        "MATRIX":  HDF_VD_WRITE, vds, "MATRIX", $
                ibase(j).zmat(0:ibase(j).xpts-1,0:ibase(j).ypts-1)
        ELSE:
      ENDCASE
      HDF_VG_INSERT, vg_imag, vds
      HDF_VD_DETACH, vds
    ENDFOR
  ENDFOR
ENDIF
```

```
;*** finished writing stuff, close file
IF (narrays GT 0) THEN BEGIN
  HDF_VG_INSERT, vg_data, vg_wvfm
  HDF_VG_DETACH, vg_wvfm
ENDIF
IF (nimages GT 0) THEN BEGIN
  HDF_VG_INSERT, vg_data, vg_imag
  HDF_VG_DETACH, vg_imag
ENDIF
HDF_VG_DETACH, vg_data
HDF_VG_DETACH, vg_header
HDF_CLOSE, hdf_handle
XI_print, “Done saving “+new_filename
RETURN
END ;=================== end of XI_savefile routine ===============
```

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References

IDL User's Guide, Interactive Data Language, Version 4, Research Systems, Inc., March 1995.

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R. Bracewell, *The Fourier Transform and Its Applications*, McGraw-Hill, New York, 1965.

R. B. Spielman, *A Non-Recursive Lowpass Digital Filter Algorithm*, Sandia National Laboratories Report No. SAND82-0930, November 1982.

W. B. Boyer, *Computer Compensation for Cable Signal Degradations*, Sandia National Laboratories Report No. SAND87-3072, December 1987.

List of Distribution Files

In xdamp4XXX.tar, xdamp4XXX.zip or xdamp4XXX.exe file

xdamp.pro	Main procedure
xdamp.ini	sample *xdamp* initialization file
xdampmanual.pdf	Acrobat Reader version of the manual
pwmv.dcf	sample command file
XI_auto.pro	automatic execution files
XI_das.pro	differential absorption spectrometer routines
XI_edit.pro	edit menu procedures
XI_etest.pro	error testing procedure
XI_file.pro	file menu procedures
XI_fltr.pro	filter procedures
XI_input.pro	input procedures
XI_legnd.pro	legend procedure
XI_ops_1.pro	single waveform operators procedures
XI_ops_2.pro	dual waveform operators procedures
XI_user.pro	user modifiable operators procedures
XI_optns.pro	options procedures
XI_others.pro	routines from other libraries
XI_print.pro	print menu procedures
XI_pulse.pro	pulse parameter calculation procedures
XI_query.pro	query box procedures
XI_subs.pro	sub-widget box procedures
XI_tools.pro	tools menu procedures
XI_user.pro	user modifiable procedures
XI_utils.pro	utility procedures
XIsys_sp.pro	system specific procedures
XI_anote.cmn	array notes common
XI_bases.cmn	widget bases common
XI_data.cmn	data block common
XI_fltr.cmn	filter widget common
XI_fnote.cmn	file notes common
XI_geta.cmn	get array common
XI_jrnl.cmn	journal common
XI_optns.cmn	options widget common
XI_plot.cmn	plot information common
XI_query.cmn	query widget common
XI_regs.cmn	registers common
XI_stack.cmn	data stack common
example.hdf	sample hdf data file
example.csd	PSPICE sample data file
example.txt	EXCEL sample data file

separately

AAREADME.TXT	Installation advice

Distribution

9	MS1179	W. P. Ballard, 8732
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1	MS0899	Technical Library, 9616
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2	MS0619	Review & Approval Desk, 12690
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