WAVEWIN

FILE MANAGER
& ANALYSIS

QUICK START

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Acknowledgments

Preface

This document contains information about the Wavewin file management and Analysis capabilities. The document also describes the numerous display drivers provided.

This document is intended for use by individuals working in protection, engineering, and system operations.

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C H A P T E R 1

System Requirements & Installation

This chapter lists the system requirements needed for installing and running the Wavewin software. It also describes the installation procedures and provides technical support information.

System Requirements

The system requirements are listed below.

- An IBM or compatible PC with an 80486 microprocessor or higher.
- 500 Megabytes of memory.
- 2 gigabytes of available hard disk space.
- Microsoft Windows version XP or higher.

Installation

The system files are distributed in a compressed format. To install the software, follow the instructions for the type of storage media distributed with this manual.

Web: To install the software from the Web, access the www.wavewin.net web site. Under the "Wavewin Upgrades" link click on the Wavewin application to download. Enter your username and password to get access to the download page. The username and password are case sensitive. Click on the software link to download the latest system's zip file. Unzip the contents of the downloaded zip file to a directory off the computer's root drive, c:\Wavewin32.

USB: To install the software using a USB drive, place the USB drive into the USB port. Navigate to the installed drive using Windows Explorer and copy all the files to a directory off the computer's root drive, c:\Wavewin32.

The installation is now complete.

Starting the Software

After you have installed the software on your computer, you are ready to begin. How you begin depends on your own style. If you like to dive right in and learn by doing the system provides on-line help to assist you. If you prefer a structured learning approach, read the quick start chapters to get familiar with the software.

To run the software, navigate to the Wavewin install path and double click on the Wavewin32 shortcut.

Technical Support

Although this system is easy to use and understand, at some point you may encounter a technical question, feel that the system has improperly operated, or have suggestions for future improvements. In either case, contact Softstuf using one of the following methods:

Phone: 800-818-3463, 215-922-6880, hours are from 9:00 a.m. to 6:00 p.m. Mon- Fri, (EST).
E-mail: support@softstuf.com, response time 24 hours.

C H A P T E R 2

File Manager Quick Start

This chapter describes the main features of the File Manager.

File Manager Features

The File Manager is used to manage files on disk, search the contents of a drive or directory, and edit, plot, or draw the contents of a file. This feature is similar to Windows Explorer with application specific functions tailored for the Power Utility Industry. The functions include automatic event file association, specialized copy/move engines, intelligent queries, specialized report files, COMTRADE conversion and compression routines, merge and append waveform and load files, event summaries, and calibration reports.

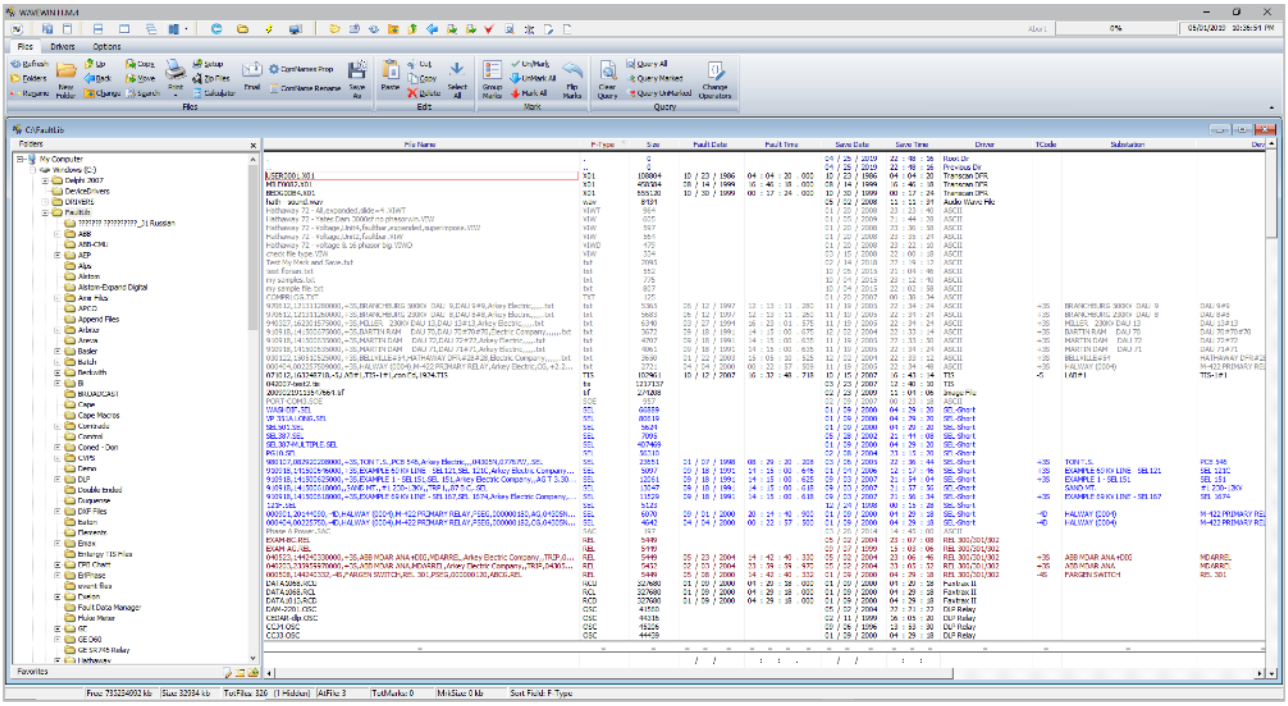


Figure 2.1 File Manager

When the software is activated, the File Manager displays the subdirectories and files of the last active drive and directory. This window consists of a folder tree, file table and a query bar. The query bar is located below the table. The main features are described in the following sections.

LONG FILE NAMING FORMAT (COMNAMES)

The File Manager supports the IEEE long file naming format C37.232. The IEEE long file naming format is a PSRC format used to name time sequenced data files. The file table columns are used to display the contents of the long file names. The file name contains the first ten fields stored in a comma-delimited fashion. The remaining fields are optional. The file table lists four optional columns at the end of the table to support user defined fields. The ComNames properties dialog allows for user input for the first two optional fields.

Example: 000112,123433234,-5S,South Arkey,DLP1,Sun Power,,123.22,+34.6,AG T.OCS

Field Definitions:

Field	Example	Displayed	Definition
Date	000112	01/12/2000	The Date field defines the start date of the file. The date fields are defined as: the first two characters are the year, the next two are the month and the last two are the day. (required)
Time	123433234	12:34:33.234	The time field defines the start time of the file. The Time fields are defined as: the first two characters are the hour, the next two are the minutes, the next two are the seconds and the last two or three are the milliseconds. (required)
Tcode	-5S	-5S	The TCode field is the time offset from GMT time. If the start time is expressed in UT, this field is coded 0z, **Note:** GMT is the international abbreviation Greenwich Mean Time. (required)
Substation	South Arkey	South Arkey	The substation name or code where the originating device is located. (required)
Device	DLP1	DLP1	The device name or code that generated the file. (required)
Company	Sun Power	Sun Power	The company of the specifed substation. (required)
File Tag	T	T	The fault type or contents type of the file. (optional)
Line Length	123.22	123.22	The line length extracted from the event file. This field applies to certain relays. (optional)
Fault Location	+34.60	+34.60	The fault location extracted from the event file. This field applies to certain relays. (optional)
Fault Type	AG T	AG T	The fault type extracted from the event file. This field applies to certain relays. (optional)

COMNAME(S) RENAME

To rename time sequenced data files using the IEEE long file naming format select the ComName(s) Rename icon under the File tab. ComName(s) Rename will rename all the marked waveform files to the IEEE PSRC long file naming format. A message box will be prompted before renaming the file to ensure the execution of the rename feature. This feature will permanently rename the files. It is advisable to back up the files before renaming. Some proprietary applications may not be able to read the files once they are renamed. For a full description of the format refer to the Long File Naming Format.

For specific display driver's, information from the file is placed in the long file names.

- SEL Files: The user fields have the Line Length, Fault Location, and the Event Type (example type field: ",100, 86.0, CG T").
- DLP Files: The user fields have the Fault Type, Distance and Trip Type in the type field (example type field: ",AG 001.8 PLT,").
- Transcan Files: The 1st User Field has the 4-character station ID (example user field: ",BEDG,").
- Rochester Files: The 1st User Field has the 5-character header name (example user field: ",20626,").
- Hathaway Files: The #DAU ID data is added next to the device name (example device field: ",DAU 8#8,")

All files associated with the marked files will also be renamed.

- Comtrade files: the ".CFG", ".INF", ".HDR", ".DAT" and "*.D##" files will be renamed.
- Faxtrax files: the ".CTL", ".RCD", ".RCL", ".RCU" and ".RCS" files will be renamed.
- Rochester files: the ".PRE" file and all files with the same name and a ".###" extension will be renamed.

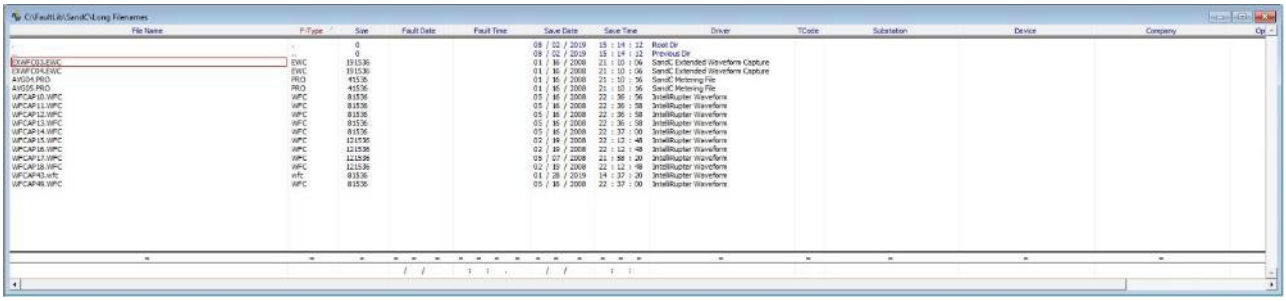


Figure 2.2 ComNames Rename: Select and Mark all the Waveform Files to Rename

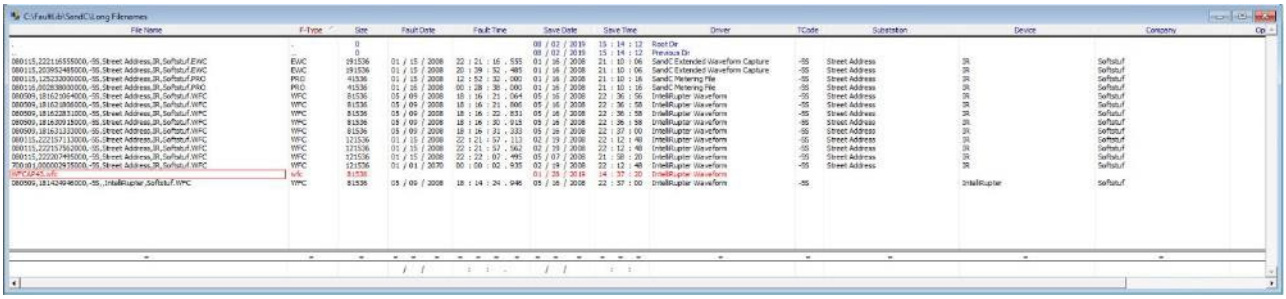


Figure 2.3 ComNames Rename: Result

COMNAME PROPERTIES

The fields defined in the IEEE long file naming format are not always available from the time sequenced files. The ComNames Properties dialog allows for setting the most common fields not available in the time sequenced files. To open the ComName Properties dialog select the ComName Prop icon located in the File tab. User fields allow for setting specific information into the file name.

- Company Name
- Time Code
- User Field 1
- User Field 2

The fields entered are used for all files renamed.

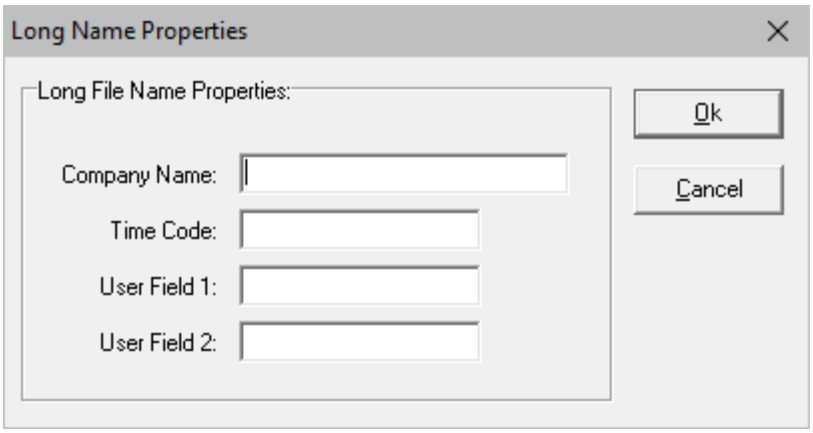


Figure 2.4 ComName Properties Dialog

COMMAND LINE PARAMETERS

Command line parameters are supported in the Wavewin software. The listed command line parameters are specific for the file manager and data plotting. Below is a list of all supported command line parameters and their descriptions:

Command Line	Description
Path and Filename	If a path and filename is passed as a command line parameter the path and filename must be surrounded by quotes, such as "c:\faultlibrary\event1.dat". Wavewin will automatically open and display the file. Only the file is opened in Wavewin. To display the file manager, click on the File menu button  .
/Print	The "/Print" command line parameter is used along with a path and filename command line. It automatically opens, displays, and prints the file when Wavewin is executed.
/Comtrade	The "/Comtrade" command line parameter is used along with a path and filename command line. It automatically converts a file to the IEEE C37.111 Comtrade Standard. The passed parameter is /Comtrade. To retain the original file name of the source file, use the /Comtrade passed parameter. To have the file automatically named using the IEEE C37.232 file naming format use the /Comtrade=1 passed parameter. The /Comtrade command line parameter can also be used in batch files. The converted Comtrade files are saved in the same directory as the source file. The new passed parameter will convert the source file to Comtrade. **Comtrade Commands**: • /Comtrade - Convert the Specified Files to the ASCII 1999 format. The original file name is used when naming the Comtrade Files. • /Comtrade=1 - Convert the Specified Files to the ASCII 1999 format. The IEEE Long file name is used when naming the Comtrade Files. • /Comtrade=2 - Convert the Specified Files to the ASCII Comtrade Format specified in the Data Plotting Properties Dialog under the Comtrade tab. The IEEE Long file name is used when naming the Comtrade Files. • /Comtrade=3 - Convert the Specified Files to the Binary Comtrade Format specified in the Data Plotting Properties

	Dialog under the Comtrade tab. The IEEE Long file name is used when naming the Comtrade Files. Below are some examples: Examples: ---------- 1.) Passed Parameter: "c:\faultlib\shipdir\SEL-421.CEV" /Comtrade=1 Comtrade Filename: 011207,145119291000,-5,Station A,Relay 1,SOFTSTUF,TRIP,,SOTF B_PHASE C_PHASE GROUND 50,60.00.DAT 2.) Passed Parameter: "c:\faultlib\shipdir\DATA1068.RCD" /Comtrade Comtrade Filename: c:\faultlib\shipdir\DATA1068.DAT
/Batch	The “/Batch” command line parameter is used along with a path and batch filename command line. It automatically opens the defined batch file and executes each command line parameter defined in the file. This feature is used mainly to process each file and extract key features from each file and save to a comma delimited file or for converting a number of files to Comtrade through one command line parameter.
/Merge	The “/Merge” command line parameter is used along with a path and filename command line. It will merge the file with all files that have a /merge command line parameter associated with them. The /merge command line parameter is defined in a Merged File.lst ASCII file. The Merged File.lst is passed to Wavewin through the command line parameters. All files listed in the Merged File.lst are automatically merged by time. If the files have different sampling frequencies the highest frequency is used. The merged file is saved as an ASCII 1999 Comtrade file and placed in the same directory where the Merge File.lst is located. The Comtrade files are named Merged File.cfg and Merged File.dat. If an error occurs a Merged File.log file is created listing all errors encountered. Example contents of a Merged File.lst: C:\faultlibrary\event10.dat /merge /exit C:\faultlibrary\event12.dat /merge /exit C:\faultlibrary\event14.dat /merge /exit
Fault	Automatically display the Fault Data Manager when Wavewin is ran.
SOEList	Automatically display the SOE List manager when Wavewin is ran.
/X	The “/X” command line parameter tells where to display Wavewin’s left corner when executed.
/Y	The “/Y” command line parameter tells where to display Wavewin’s upper corner when executed.
/W	The “/W” command line parameter tells the width of the Wavewin application when executed.
/H	The “/H” command line parameter tells the height of the Wavewin application when executed.
/Exit	The “/Exit” command line will automatically exit Wavewin after all other command line parameters are fully complete.

NAVIGATING

Files:
To browse the files in the active directory, use the up, down, right, left, page up, page down, home, end, ctrl+home, and ctrl+end keys, or use the scroll bars.

Drives/Directories:
To view the contents of a folder, navigate through the folder tree or place the cursor on the folder name in the file table and press <enter> or double click on the desired folder. The "**.**" and "**..**" displayed at the top of the file table provide shortcuts to the previous folder and the root directory. To return to the previous folder, place the cursor on the "**..**" shortcut and press <enter> or click the Up  icon or press the backspace key. To return to the root folder, place the cursor on the "**.**" shortcut and press <enter>.

To change the active drive letter, click the ChDir  icon or press F7. Enter the drive letter/path and click OK. To return to the last active folder, enter only the drive letter. To display the contents of the root folder, enter the drive letter, a colon, and a backslash, for example type "C:\". An error message is displayed if the software cannot find or open the specified folder.

To navigate through the last active folders, click the Back  menu button or click the right mouse button to display a list of the connected drives and the last 12 navigated folders.

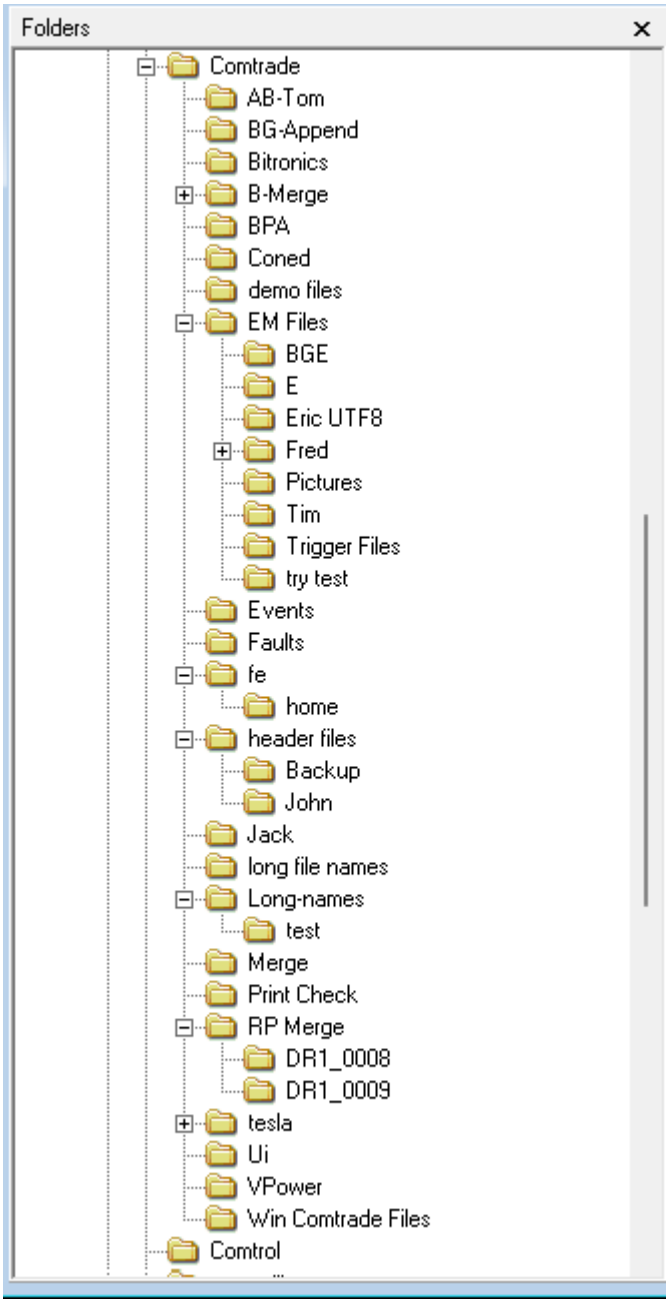


Figure 2.5 Folder Tree

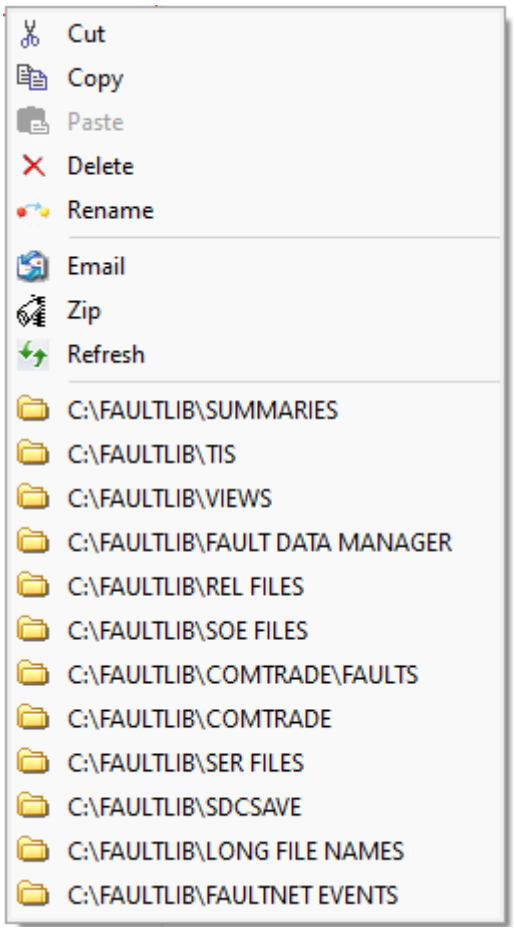


Figure 2.6 Drive/Directory Navigation Menu

FAVORITES BAR

The Favorites Bar allows for quick access to all your most navigated folders.

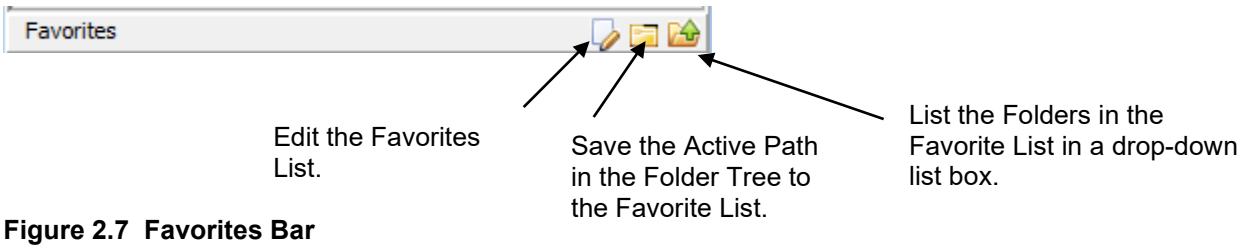


Figure 2.7 Favorites Bar

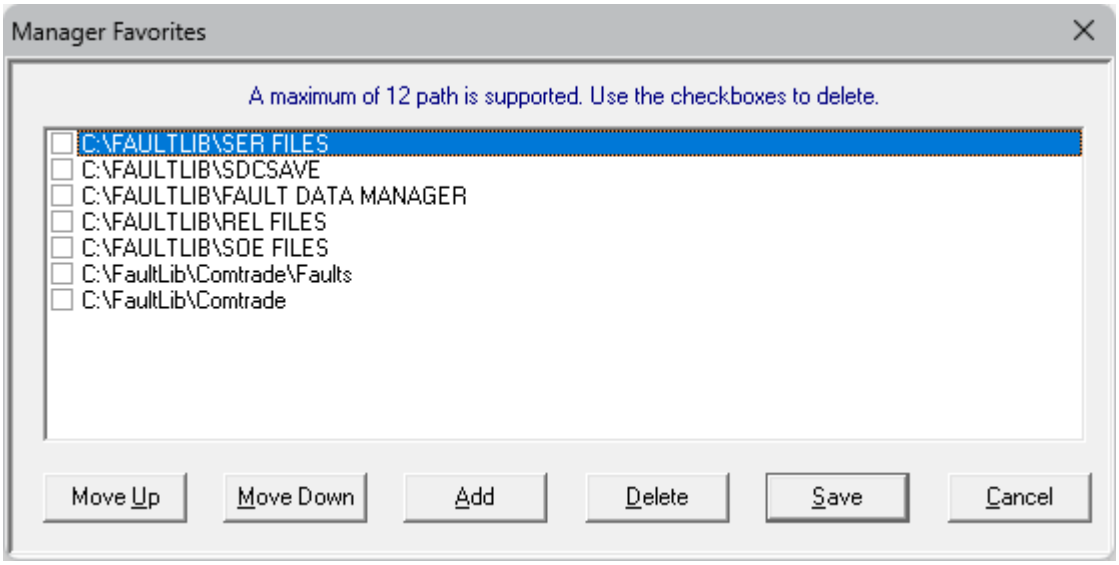


Figure 2.8 Edit Favorites Bar

The table below details the action for each button in the Manager Favorites dialog.

Button	Action
Move Up	Move the selected row up one position. Only one row can be selected at a time.
Move Down	Move the selected row down one position. Only one row can be selected at a time.
Add	Add a new directory to the list.The microsoft select directory dialog is displayed.
Delete	Delete all the directories with a ccheck mark.
Save	Save all the changes.
Cancel	Leave the dialog without saving any of the changes.

REFRESH THE ACTIVE DIRECTORY

Click the **Refresh** menu button to update the contents of the folder tree and the file table or press F12. To refresh only the folder tree right click on the folder tree and select the **Refresh** option. To refresh only the file table right click on the file table and select the **Refresh** Refresh menu option.

Figure 2.9 Folder Tree Popup Menu

MARKING FILES

Files are marked and unmarked through the mark icons in the File tab, the space bar, or the mouse button. Use the shift+left mouse button to mark a group of files or the ctrl+left mouse button to randomly mark files. Marked files are displayed in red and can be copied (F8), moved (F9), deleted (Delete), grouped, sorted, or plotted.

SORTING FILES

The column headers displayed at the top of the table are used to sort all the files in the table. Click the header buttons to toggle between ascending and descending order F-Type The active sort field is displayed in the status bar at the bottom of the window Sort Field: Fault Date.

COPYING OR MOVING FILES

Files must be marked to copy or move them from the active folder. To copy/move files using the Window's Folder Tree dialog click the Copy To / Move To icons or press F8 for copy and F9 for move. Select the folder from the Directories tree or click on the New Folder button and enter the new directory then press <enter>. A message is displayed if an error occurs while copying or moving the files. The Cancel button or the <esc> key terminates the command.

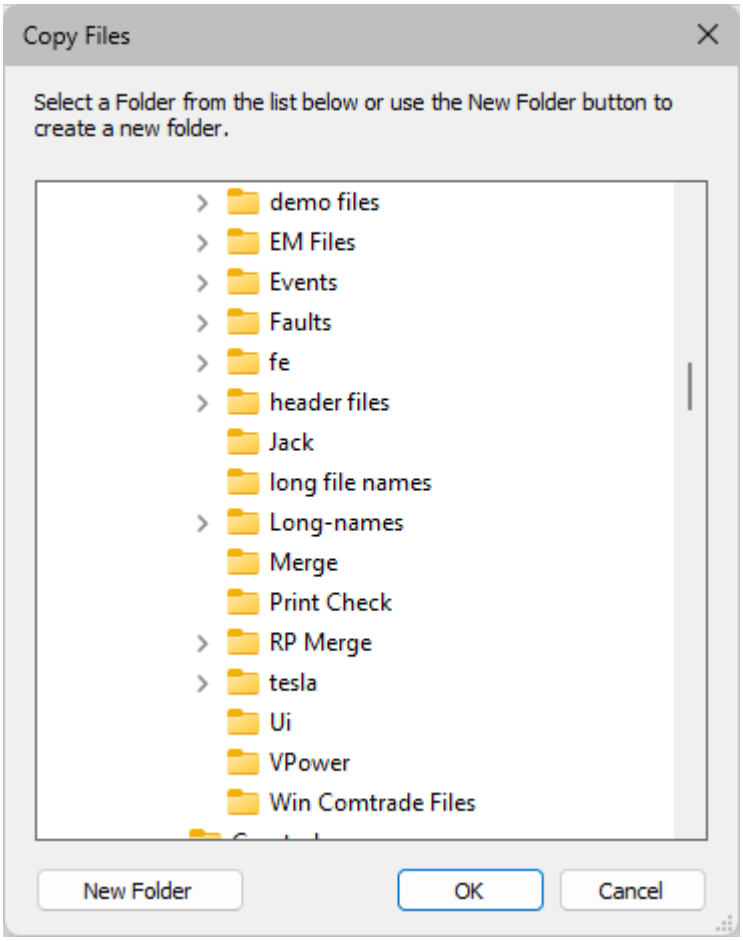


Figure 2.10 Copy Dialog

To copy or move files to the clipboard select the Copy/Cut menu options under the Edit menu or right click in the file table and select the Copy Copy or Cut Cut option from the popup menu. Navigate to the destination folder and select the Paste option under the edit menu or the Paste Paste option from the file table's popup menu.

To move files using the drag and drop feature, first mark the files in the file table then drag them to the desired folder in the Folder tree. Once the move is complete, a message box will be displayed listing the number of files moved to the selected folder.

After a copy/move or paste command is executed and a file is successfully transferred to the destination directory, the system's task bar in the upper right-hand corner of the screen is updated. All files that were unsuccessfully copied/moved using the Copy/Move features are marked and grouped at the top of the table.

The specialized copy/move/paste engine copies the COMTRADE and DFR header and configuration information along with the selected data file. For example, when a data file is copied or moved the corresponding header information (CFG, HDR, INF, DAU-DEF, SCF File, CTL File and *.PRE files…) are automatically copied from the source folder to the destination folder.

EMAIL FILES

Files must be marked first (displayed in red) to email. Mark all the files to email then click the Email icon or right click in the file table to display the popup menu and select the **Email** Email option. The users default email program is displayed with all marked files in the attachment section. Also, any support files needed to display the selected files will be automatically attached. Support files include Comtrade .CFG, .HDR and .INF files, Hathaway DAU files, Transcan .SCF and .TCF Files, Faxtrax or Director .CTL files and Rochester .PRE, Machine.DAT and Data files.

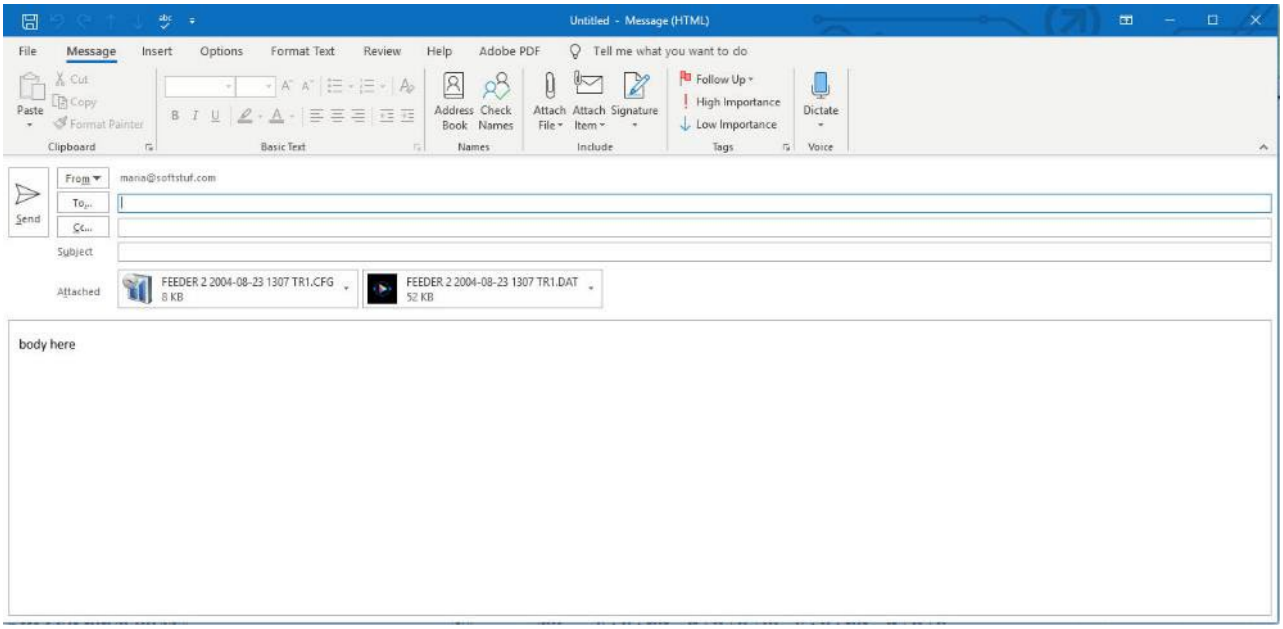


Figure 2.11 Email Dialog

ZIP FILES

To zip a group of files first mark the files. Marked files are displayed in red. To zip the marked files click the Zip Files icon under the File tab or right click in the file table to display the popup menu and select the Zip Zip option. The zip dialog is displayed. Enter the filename and folder. Click the Folder button to browse and select a destination folder. If no destination folder is defined, the zip file is saved to the file table's active folder. Also, any support files needed to display the selected files will be automatically included in the zip file. Support files include Comtrade .CFG, .HDR and .INF files. The zip files created are compatible with Windows and the WinZip application.

The Zip Marked Files dialog allows for entering a password for the zip file. To password protect the zip file enter a password in the Password field.

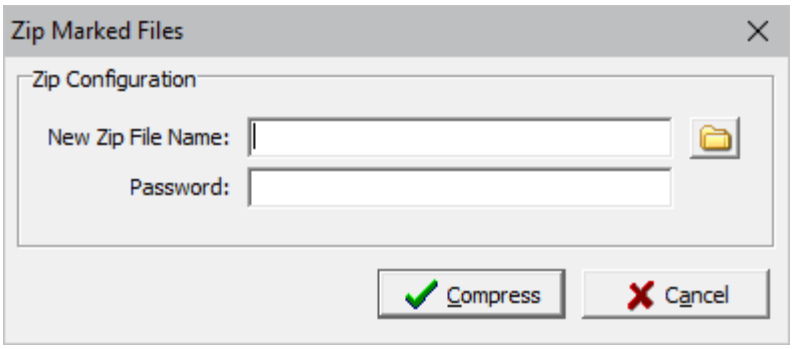


Figure 2.12 Zip Dialog

CUSTOMIZING THE TABLE DISPLAY

The columns displayed in the table can be repositioned through the Display Properties option under the Options menu/tab. Use the Move Up and Move Down buttons to change the position of a column. The table columns can also be resized. Position the mouse over the column separator in the table and drag the mouse to the desired location or double click on the table separator to resize the column to the largest display.

The size of the font displayed in the table can also be changed. Use the Table Font Size drop down list under the General Table Settings tab to select the desired font size. Also, to use the Window's default file marking, select the Windows option from the File Marking drop down list. To mark files with a single mouse click select the Single Mouse Click option.

The default path that is displayed when the file manager is first opened is defined in the Default Path field. Enter the path or use the Browse button to select the path.

To turn sorting off for the file table select No in the Sort Tables drop-down list box. The default is yes. If a large number of files exist in a directory, then the sorting can take an extended amount of time.

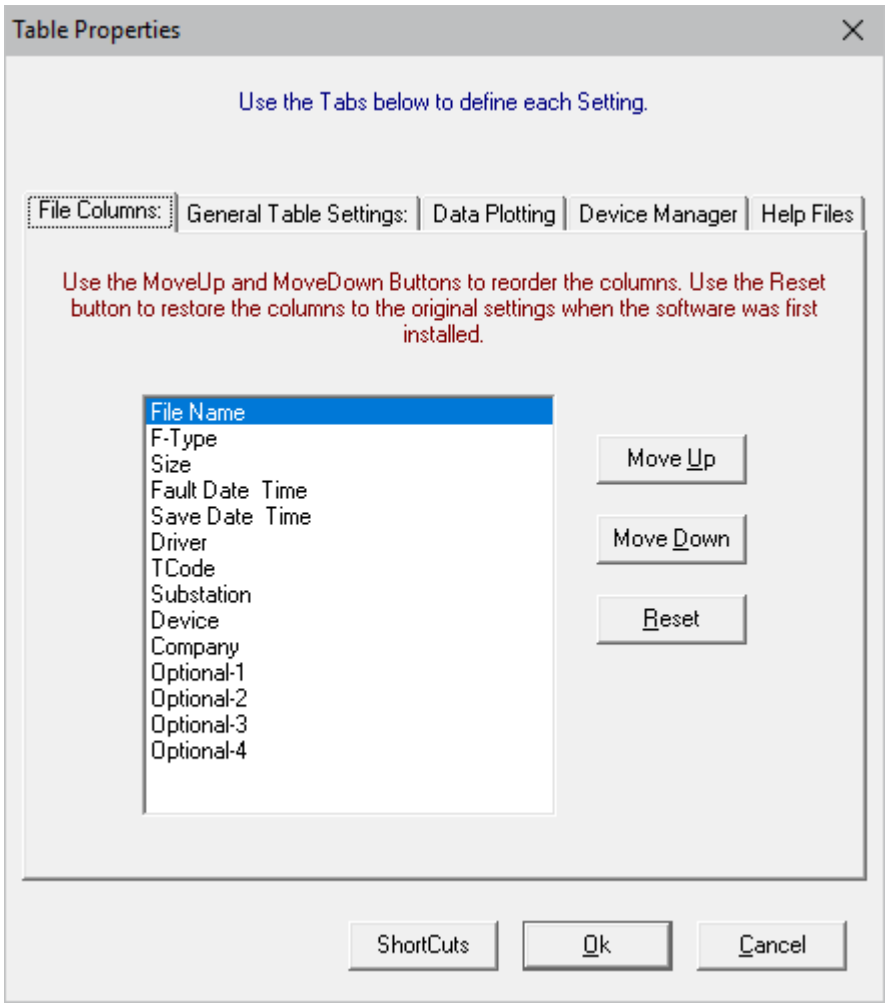


Figure 2.13 Customize Table Columns

PRINTING THE FILE TABLE

The print feature provides two options: print all or marked files in the active directory. To print all the files, select the All Rows drop down option under the Print icon in the Files tab. To print the marked files, select the Marked Rows drop down option under the Print icon in the Files tab. An error message is displayed if the software cannot access the printer port.

COMPRESSING COMTRADE ASCII FILES

The File Manager contains a built-in compression routine that converts COMTRADE ASCII files to COMTRADE Binary files. To compress COMTRADE ASCII files, mark the files and select Compress icon under the Options tab. The software prompts for confirmation, click Yes to continue, or No to cancel.

SAVE AS

Oscillography formats supported by the software can be converted to the COMTRADE ASCII or Binary format, RMS Values, Instantaneous Values and Vector Values using the Save As icon in the File tab. For Comtrade there are three Comtrade versions supported: the older 1991 format, the 1999 format and the newest 2013 format. The new 2013 Comtrade format can be saved as a single file with the CFG, HDR and DAT all contained in the single file. The new Comtrade single file format has a .CFF extension.

The Comtrade format is selected from the Save As Type field's drop-down list. To create a COMTRADE file place the cursor on the event file or mark the desired files and select the Save As icon under the File tab. Enter the destination path and filename (do not enter a filename extension) and click OK. The *.CFF or ".DAT" and ".CFG" files are automatically assigned. If a path is not defined, the COMTRADE files are saved in the active directory in the File Manager.

If the sample values in the selected file(s) are RMS calibrated and the desired Comtrade file must have instantaneous values set the Comtrade Settings fields to automatically convert the RMS data to instantaneous values. To set the Comtrade Settings fields open the Properties dialog in the analysis window. Select the Comtrade tab then select "Yes" for the Convert RMS Calibrated Data to Peak Data field.

To automatically save the selected file(s) using the IEEE long file naming format check the "Use the ComNames Naming Convention to Name the Comtrade File(s)" field in the "Save As" Dialog and leave the File Name field empty. To specify the files to Save select one of the 3 options from the Files section, Selected File, All Files in the table or just the Marked files.

The Save As RMS Values, Instantaneous Values and Vector Values saves the values to a comma delimited ASCII file. These files can be displayed in the data plotting window or opened in Excel for further analysis.

For Comtrade files, if the line impedance values and line length are available in the original file then Wavewin will save the line impedance values to the .HDR file/section. Below is an example of the information Wavewin saves in the header section of the Comtrade single file (.CFF).

If the file is an SEL file and the settings for the file are included in the original file, then the settings can be automatically written to the Comtrade's .HDR file/section. To have the SEL settings added to the Header file/section click the Save SEL Settings checkbox. The system will remember the state of the checkbox.

```
--- file type: HDR ---
Fault Information
01 - Event: BG  Location:    0.90  Shot:    Frequency:  60.03
     Targets:
     Currents (A Pri), ABCPGQ:    332  3660   316     2  3596  3580
     Line Len:  3.08

Impedance Values
Z1Mag = 2.84
Z1Ang = 66.65
Z0Mag = 8.81
Z0Ang = 68.67
LL = 3.08
```

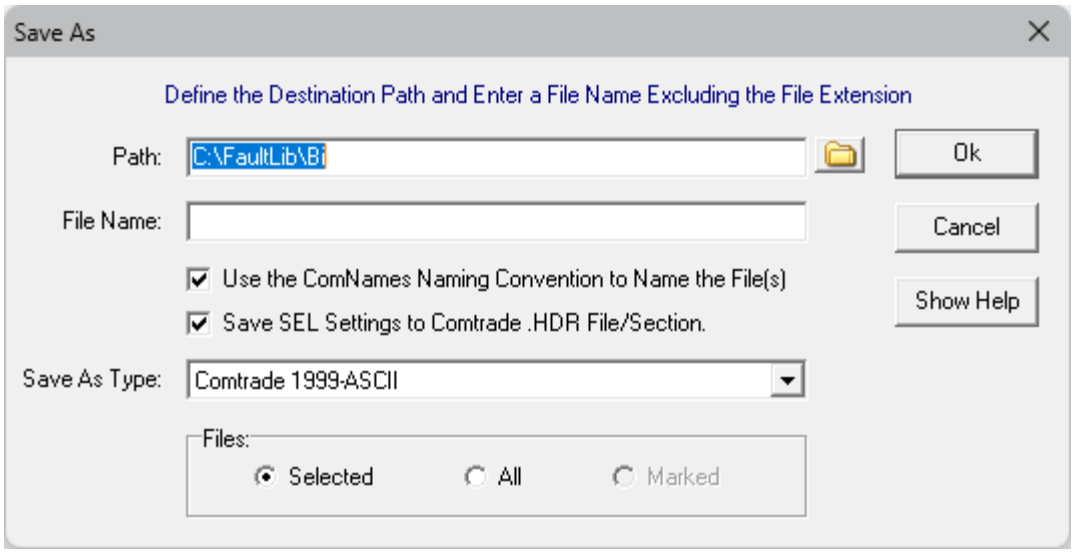


Figure 2.14 Save As Dialog

DISPLAYING OSCILLOGRAPHY RECORDS

A library of device drivers is used to display various types of oscillography formats. **The proprietary drivers below are available in the Wavewin Universal Viewer and Full versions only**. The Comtrade driver is available in all versions. The formats supported by the system are:

COMTRADE ASCII and Binary
Hathaway DFR I, II, IIB, and 2000
Emax Faxtrax & Director DFR
Mehta Transcan DFR
Rochester TR16** DFR
SEL Relays (all series including the compressed format)
ABB Relays (REL 301/302, MDAR 300, GPU, TPU & DPU 2000R and below)
ABB Load Profile (Wye-Connected VTs and Delta-Connected VTs)
GE Relays (DLP1 & DLP3)
Dranetz SER
Satec PM295
RFL 9300
SDC Log Files
Fluke Scope Meter
SEL Load Profile Data
SEL Sag/Swell/Interruption Files (SSI)
Ametek TR-100+, DL-8000, TR-2000 & P&QR128
ERLPhase Tesla
ERLPhase BPRO, TPRO, LPRO & FPRO
Emax Long Term Records
GE-SRSeries
Hathaway Replay Plus (DFR, TSS & CSS files)
TIS
S&C IntelliRupter fault interrupter Waveform
S&C PXI
S&C Extended Waveform Capture
Audio Wave File
S&C Meter
S&C Daily High Low File
Nicolet PNRF

Nicolet Power Pro WFT
Comma Delimited (Time, Channel) format
SDC Comma Delimited Files
Audio Wave Files

To plot the contents of a file, place the cursor on the filename and select the appropriate driver from the "Driver" menu. A maximum of ten display windows can be opened at one time. Refer to the "Analysis" section for more information.

ASSOCIATING FILE TYPES

The File Manager automatically associates file types according to the file naming structure and file extensions. The associated driver is displayed in the driver column. When the <enter> key is pressed, or the default mouse button is double clicked the software inspects the filename at the cursor and executes the assigned driver. **The Proprietary drivers listed below are available in the Wavewin Universal Viewer and Full versions only.** Files are associated according to the following parameters:

Driver	Association Parameter
Directories	Directories are tagged according to the parameters read from the file allocation table.
Applications	Files with the extension ".BAT", ".COM", or ".EXE" are tagged as application files.
Hathaway DFR I,II, IIB & 2000	Files that match the Hathaway Base32 file naming scheme or are long files with the .DFR extension are tagged as DFR I,II, IIB, & 2000 files.
EMAX Faxtrax II / Director	Filenames with the extensions ".RCD", ".RCL", ".RCU", and there is a cooresponding ".CTL" file, are tagged as Faxtrax II / Director files. The Emax Faxtrax II / Director (12-bit/16bit) format is supported.
Mehta Transcan	Files that have an extension starting with "X" and a corresponding ".SCF" file exists are tagged as Mehta Transcan files.
Rochester TR16**	Files that have the same name and an extension with a number and there is a corresponding .PRE file in the same directory are tagged as Rochester files.
NxtPhase Tesla	Files with the extension ".TLR" are tagged as NxtPhase Tesla files.
COMTRADE	Files with the extension ".DAT" that have a cooresponding ".CFG" file are tagged as COMTRADE files.
SEL	Files with the extensions ".SEL", ".CEV" or ".EVE" are tagged as SEL files.
SEL LPD	Files with the extension ".BSV" are marked as SEL Load Profile Data files
DLP	Files with the extension ".OSC" are tagged as DLP relays. GE DLP1 and DLP3 formats are supported.
REL300/301/302	Files with the extension ".REL" are tagged as ABB-MDAR files.
TPU/DPU/GPU	Files with the extension ".CAP" are tagged as ABB-TPU/DPU/GPU files.
ABB Load Profile	Files with the ".DLA" extension are tagged as ABB Load Profile-Wye files.
GE SR745/489 File	Files with the ".CSV" extension are tagged as GE SR745 Files.
SDC Log File	Files with the ".CSV" extension are tagged as SDC Log Files.
TIS File	Files with the ".TIS" extension are tagged as TIS (Trip Information System) Files.
Ametek Files	Files with the ".AMT" extension are tagged as Ametek TR-100+, DL-8000, TR-2000 & P&QR128 Files.
NxtPhase Relays (BPRO, TPRO, LPRO & FPRO)	Files with the ".BPR, .TPR, .LPR, FPR" extensions are tagged as NxtPhase Relay Files.
Emax Long Term	Files with the ".DAT" extension with an associated ".SET" file are tagged as Emax Long Term Files.
Hathaway Replay	Files with the ".DAT" extension with no ".CFG" associated with it are tagged

Driver	Association Parameter
Plus	as Hathaway Replay Plus Files.
S&C IntelliRupter fault interrupter	Files with the extension ".WFC" are tagged as S&C IntelliRupter fault interrupter Waveform Files.
Nicolet Power Pro WFT	Files with the extension ".WFT" are tagged as Nicolet Power Pro WFT Files.
Nicolet PNRF	Files with the extension ".PNRF" are tagged as Nicolet PNRF Files.
S&C PXI	Files with the extension ".TSV" are tagged as S&C PXI Waveform Files.
S&C Extended Waveform Capture	Files with the extension ".EWC" are tagged as S&C IntelliRupter fault interrupter Extended Waveform Files.
Audio Wave	Files with the extension ".WAV" are tagged as Microsoft's Wave Files.
S&C Meter	Files with the extension ".PRO" are tagged as S&C IntelliRupter fault interrupter Meter Files.
DXF	Files with the extension ".DXF" are tagged as Drawing Exchange Format files.
Application Files	Word Documents (".Doc" & ".RTF") , Execl Documents (".XL", ".XLS", ".XLT", ".XLM", ".XLA", ".XLC" & ".XLW") , Web pages (".HTM", ".HTML", "MSPX" & "ASP") , Access Files ('"MDB" & ".ADP") , Power Point Presenation files (".PPT" & ".PPS") , Image files (".GIF", ".TIF", ".JPG", ".JPE", ".BMP", ".PSD" & ".PDD") , Zip files (".ZIP") , and PDF files (".PDF") are automatically associated with their source application.
ASCII	All other files are tagged as ASCII files.

To change the driver type, place the cursor on the filename and select the driver from the Drivers tab. Once a driver is assigned the file contents appear in the corresponding display window. If the driver encounters an error while reading a file an Invalid Driver Message is displayed indicating the line number in which the error was encountered. Use the ASCII or Hexadecimal editors to locate and correct the error. The ASCII and hexadecimal editors display the cursor's line and character number in the lower left corner of the window.

DEVICE CONFIGURATION

The device configuration dialog allows for setting certain parameters for each type of device driver supported. To open, select the Driver Config icon option under the Options tab. The right panel displays all the supported device drivers. **The Proprietary drivers listed in the right panel are available in the Wavewin Universal Viewer and Full versions only** Use the mouse or up and down arrow keys to select the device. The left panel displays the available settings for each device. Below is a list of the available settings:

- **Device's Data Type:** Options (Peak, RMS Calibrated or Log File). Select the type of data that is contained in the files for the selected device.

- **Device Header Directory:** If the device requires support files to display the data then the support files can be placed in a centralized directory so they do not have to be in the directories where the data files are located. Enter the directory or use the folder button to browse for an existing directory. This field is for devices that maintain separate files for the Analog & Digital information. This field is available for Hathaway, Transcan, Rochester and Comtrade Files.Line group files used to define lines in DFR files can also be placed in a centrialized path, so they are accesiable to all users.

- **Change Sampling Frequency:** This field is used to automatically change the sampling frequency when a file is displayed for the driver. For example, if the files have 4 samples per cycle and it is preferred to view the file with 40 samples per cycles enter 2400. To maintain the original frequency leave this field blank or set to 0.00.

- **Change Line Frequency:** If the line frequency is not defined in a specific driver's files then the line frequency can be defined in this dialog. The entered line frequency will be used when displaying files for the selected driver. To maintain the original line frequency, leave this field blank or enter 0.00.

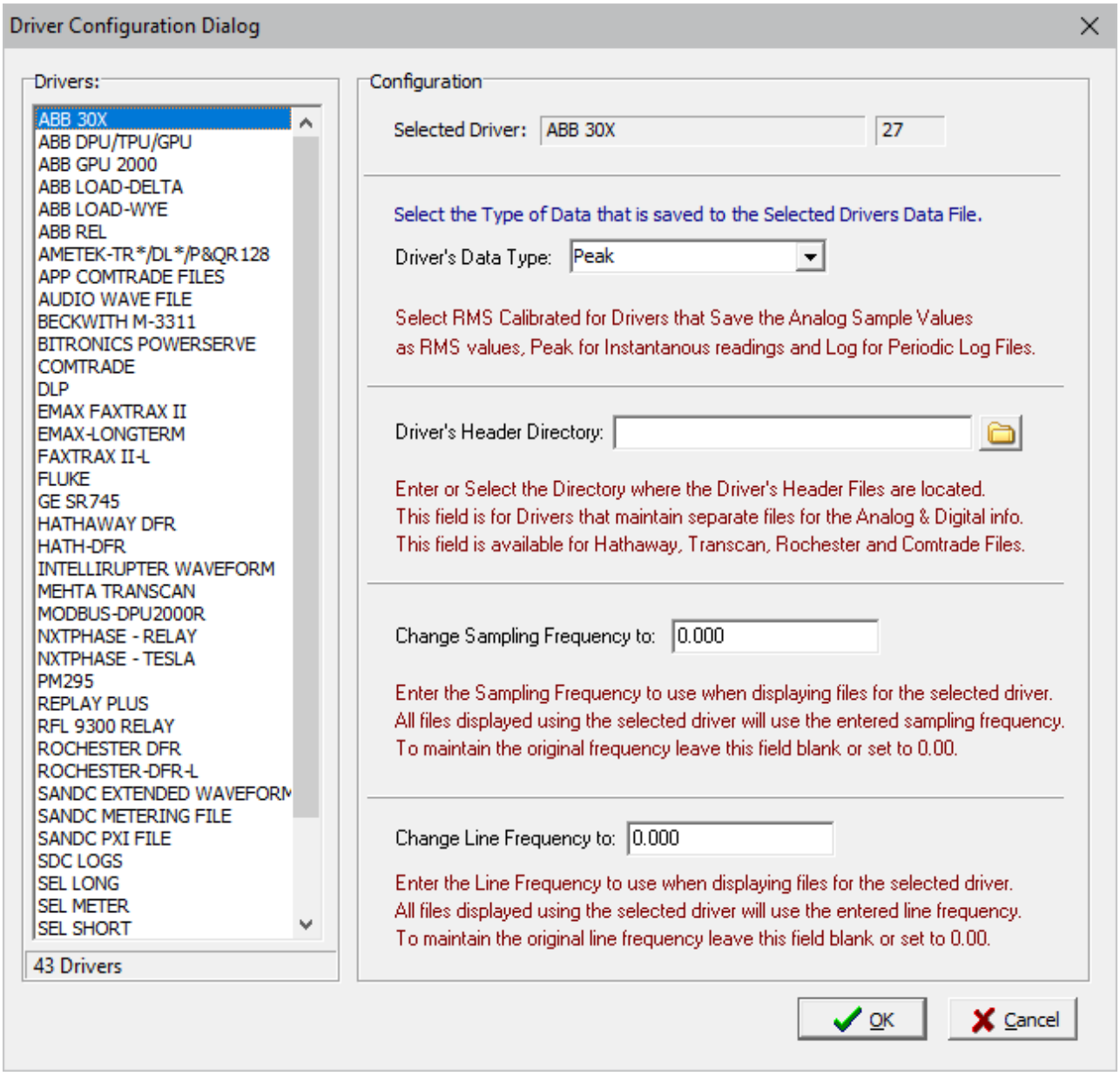


Figure 2.15 Device Configuration Dialog

DAU-DEF EDITOR

The DAU-DEF editor allows for changing the setting for all the available devices defined in the selected Hathaway DAU-DEF file and for adding new dau def configurations. To open, select the Edit DAU-DEF icon option under the Options tab. Navigate to the desired directory and double click on the dau-def file. The right panel displays all the devices defined in the file. Use the mouse or up and down arrow keys to select the device. The left panel displays the available settings for each device. Below is a list of the available settings:

- **Station Name:** Enter or change the station name.
- **Telephone #:** Enter the telephone number to connect to the device.
- **Analog Channels:** The analog channels defined for the selected DAU-DEF record are displayed in a list box. Use the up and down arrow keys or the mouse to select the analog channel to modified. The following fields can be modifed for each analog channel.
    - **Name:** Modifiy the analog channel name.
    - **Full Scale:** Modify the analog channel's full scale value.
    - **Prefix:** Modify the analog channel's prefix.
    - **Unit:** Modify the analog channel's unit.
- **Event Channels:** The event channels defined for the selected DAU-DEF record are displayed in a list box. Use the up and down arrow keys or the mouse to select the event channel to modified. The following fields can be modifed for each event channel.
    - **Event #:** Modifiy the event channel's number.
    - **Name:** Modify the event channel's name.
    - **NoNc:** Modify the event channel's normally open or normally closed value, option (1,0).
- **Sensor Channels:** The sensor channels defined for the selected DAU-DEF record are displayed in a list box. Use the up and down arrow keys or the mouse to select the sensor channel to modified. The following fields can be modifed for each sensor channel.
    - **Sensor #:** Modifiy the sensor channel's number.
    - **Name:** Modify the sensor channel's name.
    - **NoNc:** Modify the sensor channel's normally open or normally closed value, option (1,0).

To add a new DAU-DEF configuration click on anyone of the NOT USED records and fill in the analog and digital information and click Save. The DAU-KEY and DAU-TYPE files are updated automatically.

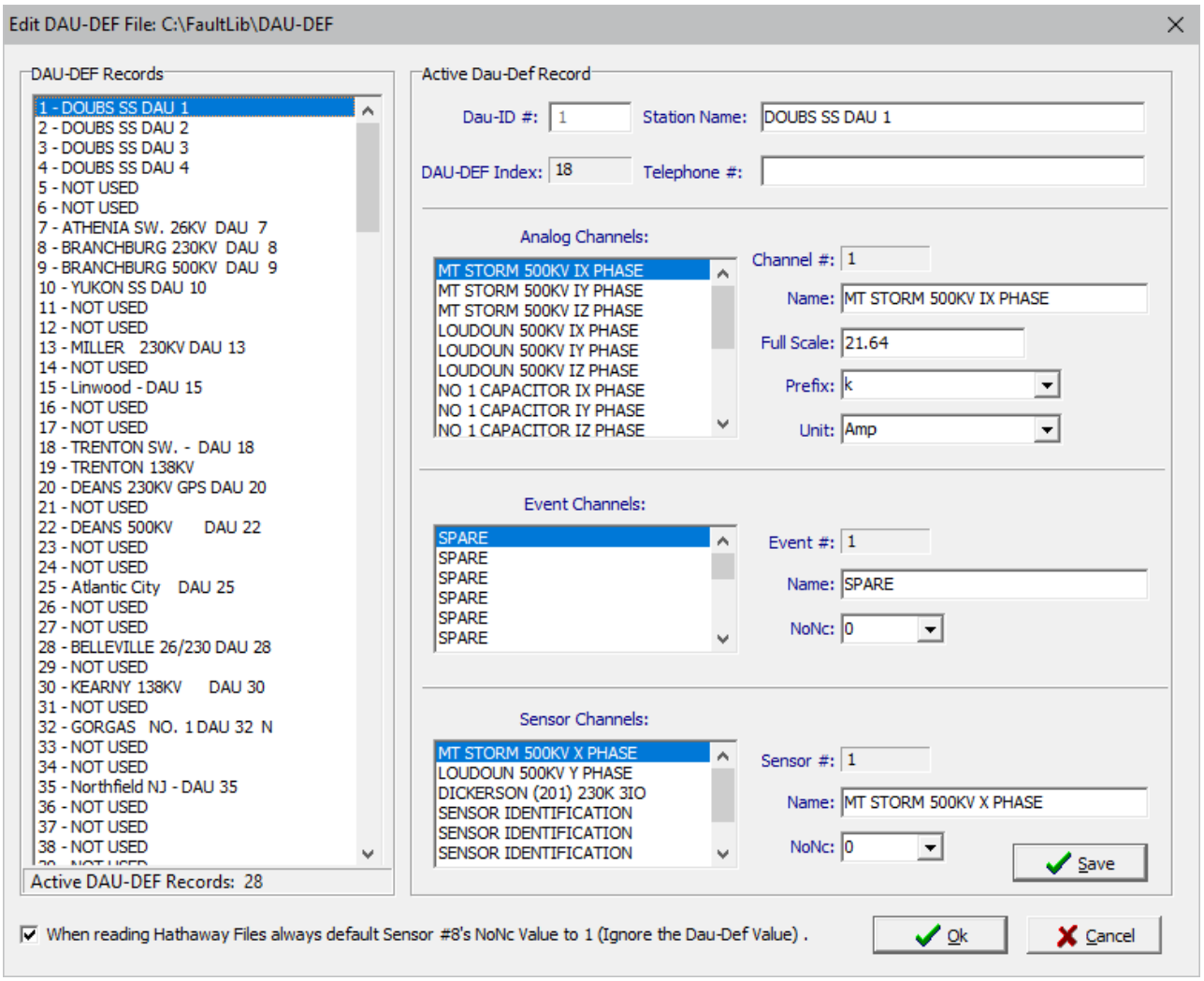


Figure 2.16 Hathaway DAU-DEF Editor

ERLPHASE FILES

ERLPhase Tesla and Relay Files are displayed in the IEEE Comtrade Binary format. ERLPhase has developed an automatic conversion DLL called RecordExAuto.dll and TeslaConfigFileRG.dll to convert their proprietary files to the Comtrade format for display. To view ERLPhase Files double click or press enter on the orginal Tesla files.

To edit the Tesla AutoComtade configuration, open the Driver Config dialog under the Options tab. Select the NxtPhase-Tesla device under the device list box. Below is a list of the available settings:

- **Use Long Name Convention:** The converted tesla files can automatically be named using the IEEE PSRC Long File Naming Convention. Select “Yes” to have them automatically renamed. If “No” is selected then the files are named using the original file name with the sampling frequency truncated to the name. Example: the “2002-07-23-15.49.01.000F1.tlr” Tesla file’s Comtrade files will be named: 2002-07-23-15.49.01.000F1-Converted_S96.dat.

- **Delete Original’s:** To delete or send the original Tesla file to the recycle bin select “Yes”. All files that can be recycled will be sent to the Window’s recycle bin all other are permentally deleted from the active drive. To maintain the original files select “No”.

- **Convert Files:** Select the files to Convert to Comtrade when the ERLPhase files are open. The options under the drop down box are Waveform Only or All Files.

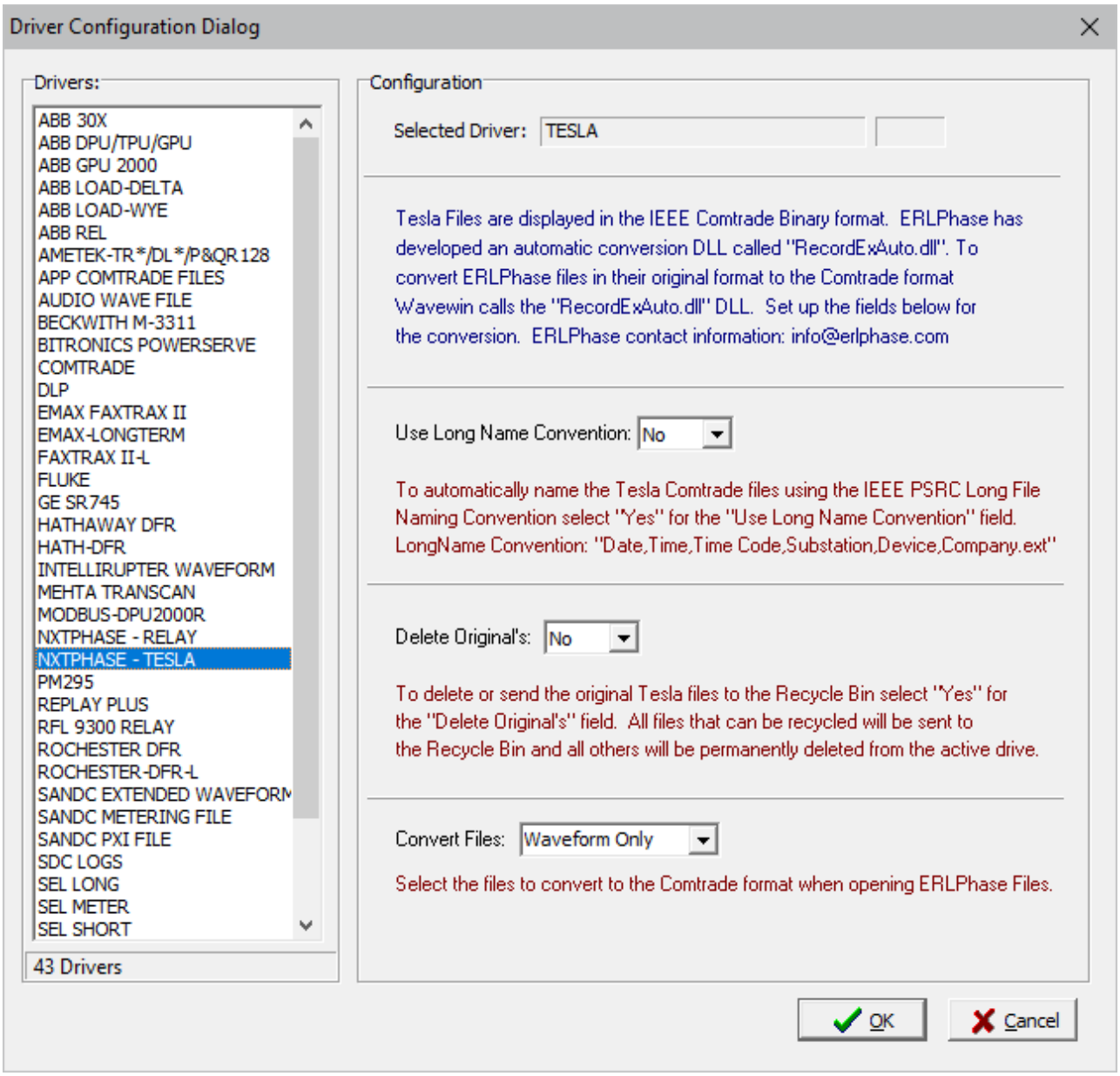


Figure 2.17 Tesla Configuration

VIEWING/MODIFYING ASCII FILES

The ASCII Editor allows for viewing and/or modifying the contents of a text file. To open an ASCII file place the cursor on the filename and press F2 or click the Edit menu button . Use the up, down, right, left, ctrl+right, ctrl+left, page up, page down, home, end, ctrl+home, and ctrl+end keys, the scroll bars or the search (F4) and search again (F3) features to navigate through the file contents. The line and character number at the cursor position are displayed in the status bar (bottom left corner of the window). The Cut (ctrl+x) , Copy (ctrl+c) , and Paste (ctrl+v) commands are also provided. New files can

be created, or existing files can be opened, saved, and saved under a new name. A maximum of ten editing windows can be opened at one time.

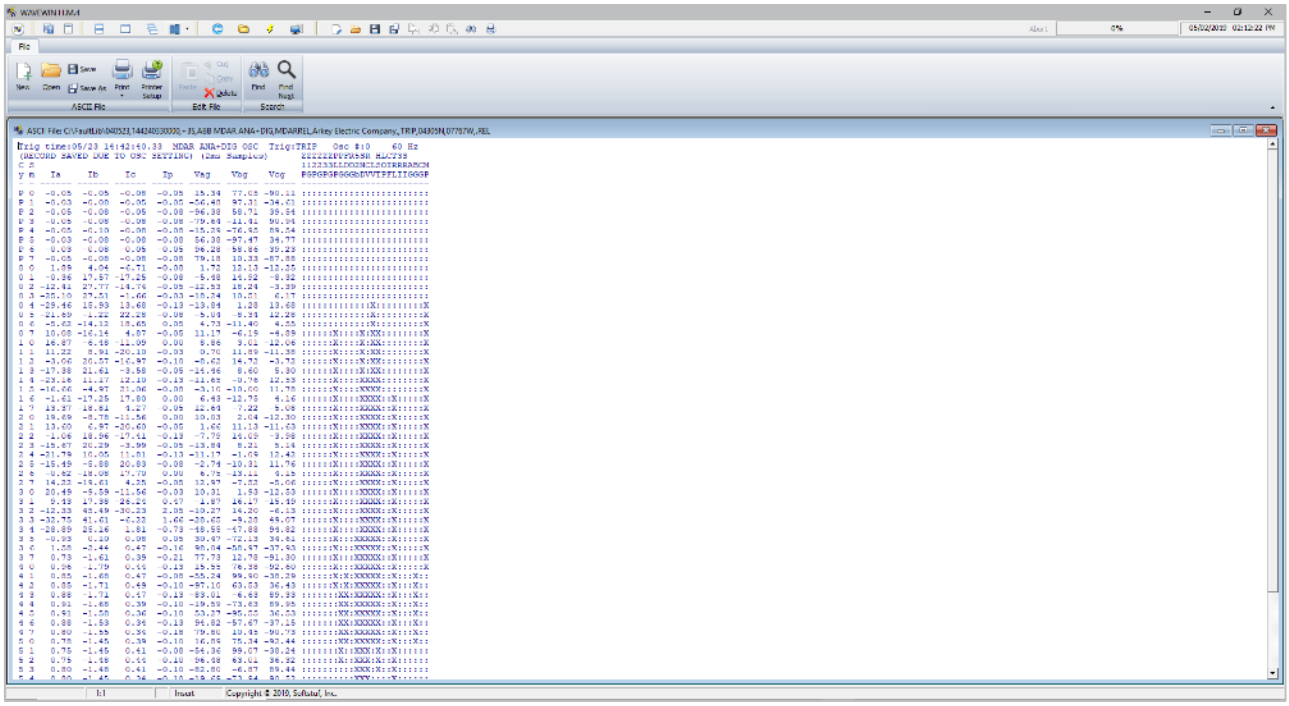


Figure 2.18 ASCII Editor

VIEWING/MODIFYING BINARY FILES

The Hexadecimal Editor allows for viewing and/or modifying the contents of a binary file. To open a binary file, place the cursor on the file and press F3 or select the Hex Editor icon under the Driver or Options tab. The Hexadecimal window consists of a hex editor and an ASCII display. When a hex value is entered, the ASCII equivalent appears in the window to the right of the editor. To navigate through the file contents, use the up, down, right, left, page up, page down, ctrl+home, and ctrl+end keys or the scroll bar. The byte number at the cursor position is displayed in the lower left corner of the window. To search the contents of a hex file, use the search (F4) and search again (F3) functions. To search the ASCII window, enter the ASCII information into the “Find Text” Field. To search for a hex value, enter “#”, then the hex number into the Find Text field.

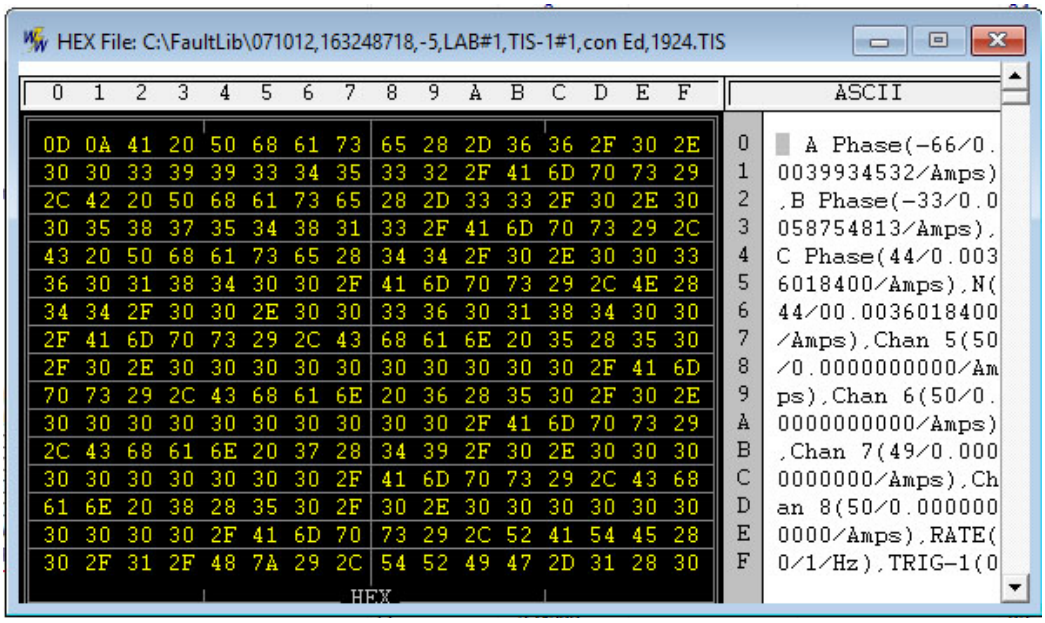


Figure 2.19 Hexadecimal Editor

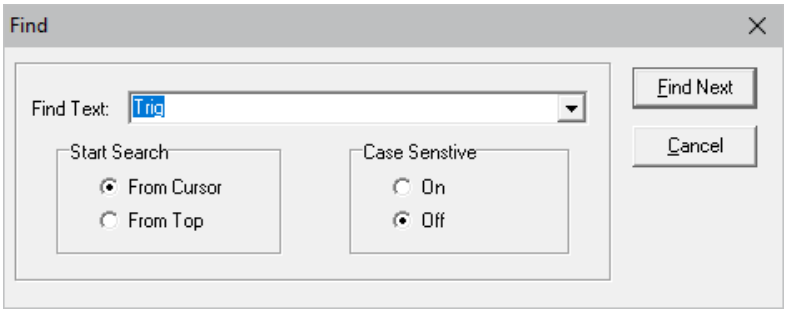


Figure 2.20 Hexadecimal Search

VIEWING WAVEFORM SUMMARIES

The File Manager and Analysis Display generates an analog and digital summary for the supported oscillography formats. The summary engine extracts key information from the file and saves it to a small summary file. The header, analog, and digital information includes:

Event Information

Field	Description
Station	Name of the Station associated with the event file.
Filename	Name of the event file.
File Size	File size (displayed in kilobytes).
Prefault-Time	Date and time of the first prefault sample.
Fault-Time	Date and time of the first fault sample.
Save-Time	Date and time the file was saved to disk.
Process-Time	Date and time the file summary was processed.
Start Date and Time	Date and time of the first sample in the file.
End Date and Time	Date and time of the last sample in the file.
File Duration	Duration of the file measured in days, hours, seconds, milliseconds and/or microseconds, depending on the type of file.
Sampling Frequency	Sampling frequency and the time between each sample.
Line Frequency	Line Frequency defined in the file.

Fault Information - Fault Information is displayed for files that include fault information in their format.

Driver	Fault Information
SEL	Event, Location, Frequency, Duration, Shot, Fault Currents, Targets and more.
DLP	Trip Date and Time, Trip Type, Fault Type, Distance and Operating Time.
Transcan	Triggered event information: Name, Time and Type.

Maximum/Minimum Analog Summary

Field	Description
Max-Inst	Instantaneous maximum values.
Min-Inst	Instantaneous minimum values.
Max-RMS	RMS maximum values.
Min-RMS	RMS minimum values.
OneBit	Channel's full-scale value divide by the channel's resolution.
Inst-Diff	The difference between the Max-Inst and Min-Inst values.
RMS-Diff	The difference between the Max-RMS and Min-RMs values.
pU	Channel prefix and unit.
Description	Channel title and number.

Events/Sensors Activity Summary

Field	Description
Fst	State at which the channel started, A=alarm and N=normal.
Lst	State at which the channel ended, A=alarm and N=normal.
Fst-Change	Date and time the channel first changed state.
Lst-Change	Date and time the channel last changed state.
Changes	Number of times the channel changed state.
Description	Channel title and number.

Events/Sensors Activity Log

Field	Description
State	State of the channel at the triggered time, A=alarm and N=normal.
Trigger Time	Time the channel-changed state.
Description	Channel title and number.

The xx:xx:xx.xxx displayed in the Fst-Change and/or Lst-Change fields of the Events/Sensors Activity Summary indicates that the digital channel's state did not change from the initial state (Fst).

To generate a summary file, place the cursor on the filename and click the Summary  menu button or select 2 options available under the Summaries icon under the Options tab.

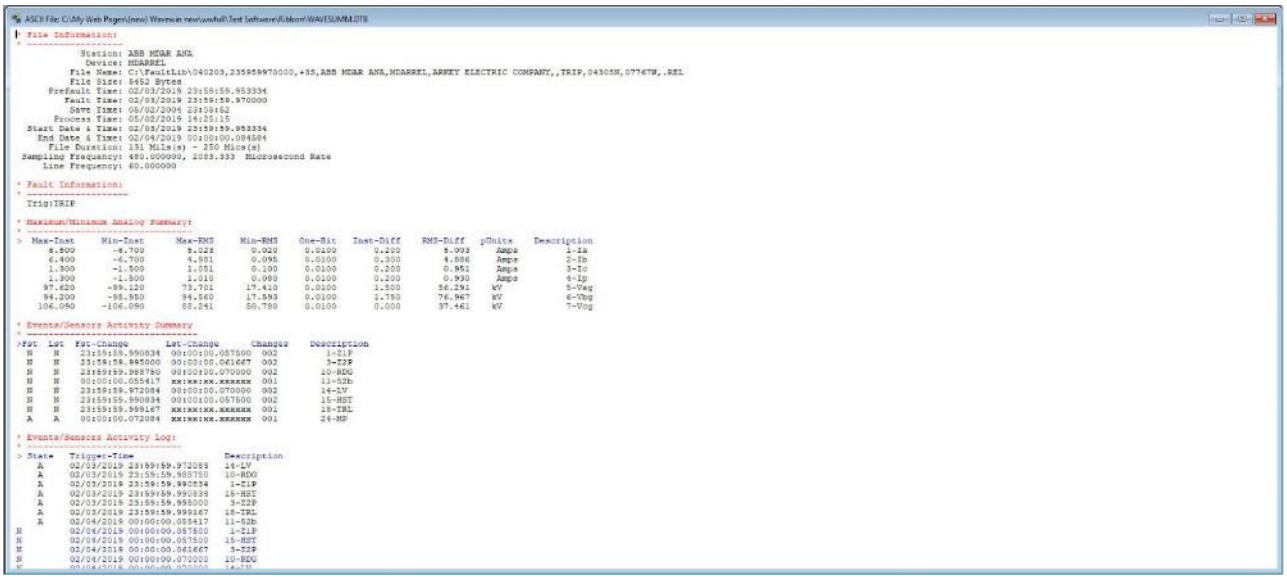


Figure 2.21 Waveform Summary

WAVEFORM FILE(S) OPTIONS

OPEN SELECTED FILE

The Open Selected File option opens the waveform file at the cursor position. Refer to the Displaying Oscillography Records section for a list of the supported waveform files.

OPEN ALL MARKED FILES

The Open All Marked Files option opens all the marked waveform files, tiles the waveform files horizontally and minimizes the file manage. To access the file manager, click the File icon  .

A maximum of ten data windows can be opened at one time.

The plot icon  will plot all the marked files. If there are no marked files, the selected file is plotted.

APPEND WAVEFORM FILES

The Append Waveform Files option appends the marked files according to time. There are two options available under the Append drop down list located under the Options tab:

- Discard Common Times: Any common times found in the marked files will be deleted from the older file.
- Back-to-Back: The files are appended back-to-back. No samples are deleted.

When the system appends files, it first finds the file with the oldest date and time. It then checks that all other marked files analog and digital channel titles and the scale factors for each analog channel match. If any of these do not match them the file is not included in the final appended display. When a file does not match a message box is displayed indicating the file will not be included in the waveform display.

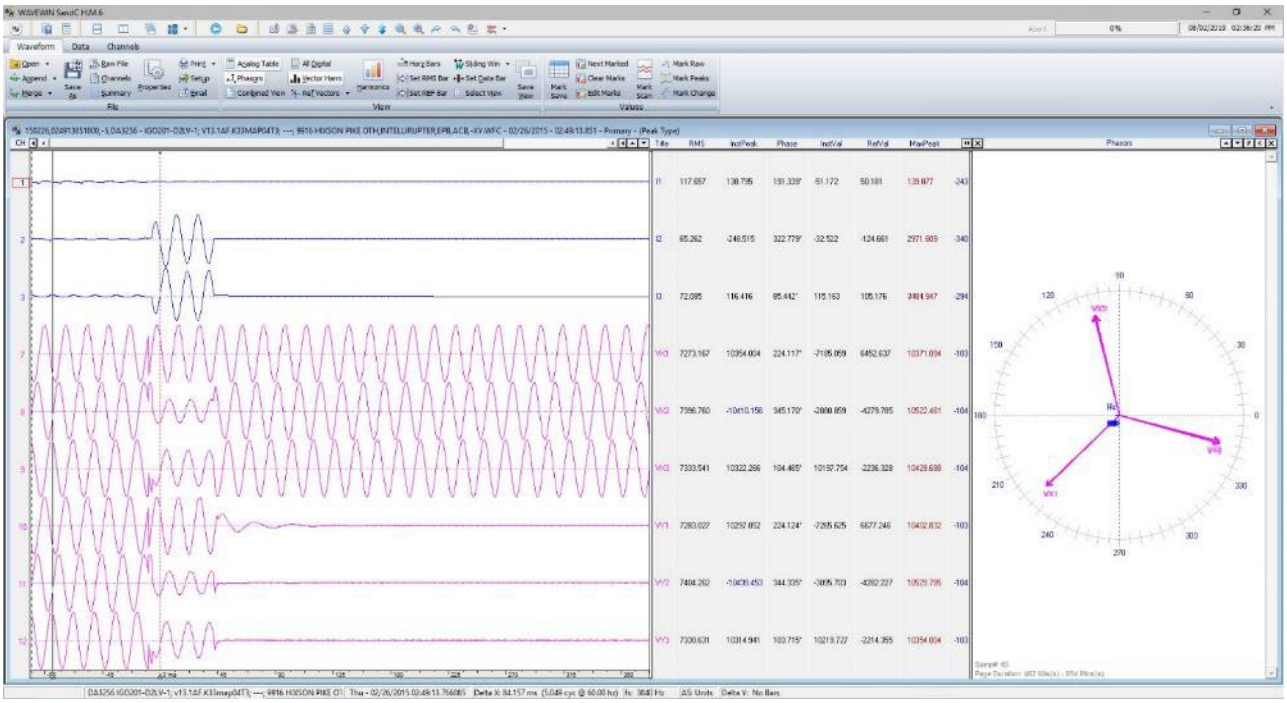


Figure 2.22 Append Waveform Files: Discard Common Times

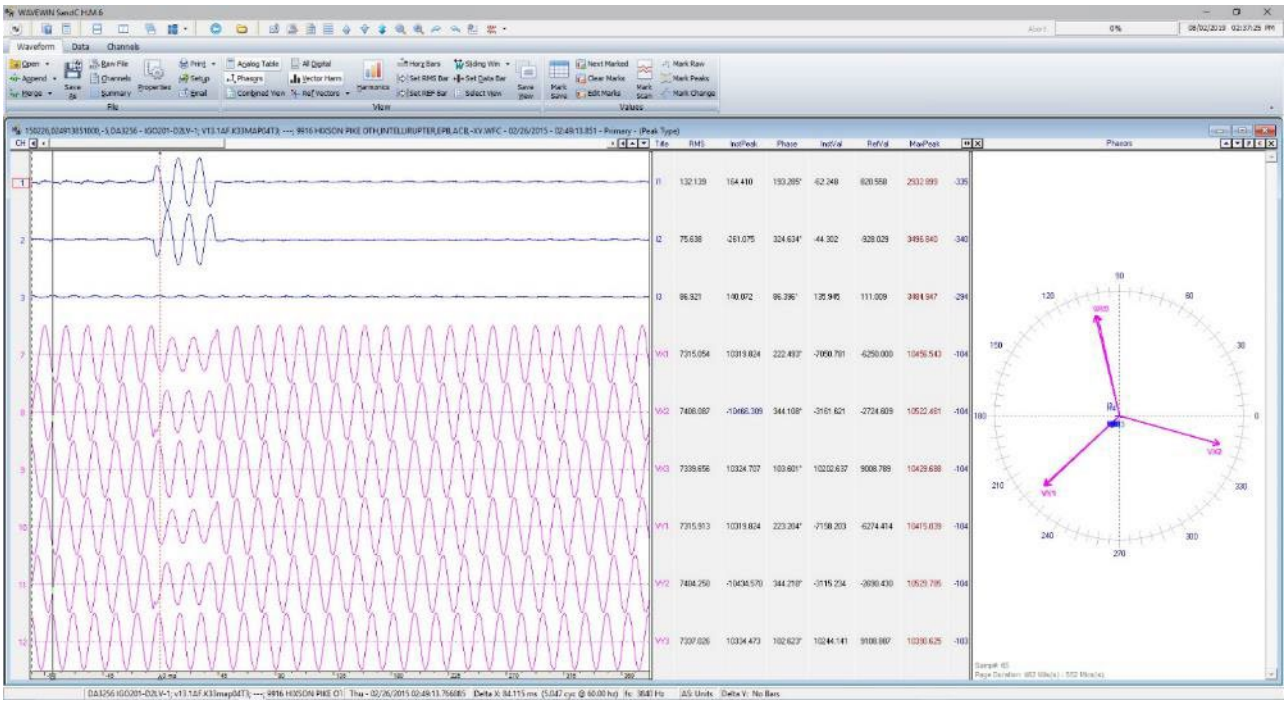


Figure 2.23 Append Waveform Files: Back to Back

MERGE WAVEFORM FILES

The Merge Waveform Files option merges the marked waveform files. There are two options available under the Merge drop down list located under the Options tab:

- By Time: Merge channel samples if they have a common time segment. The reference time is derived from the file with the latest start date and time. The file with the least number of samples determines the length of the newly merged file.
- By Sample: Merge regardless of time stamps. The reference time is derived from the first marked file. The file with the least number of samples determines the length of the file.

When files with different sampling frequencies are merged a dialog will be displayed. The dialog contains a list of all the sampling frequencies in the marked files. Select the frequency for the merged file or enter a new frequency.

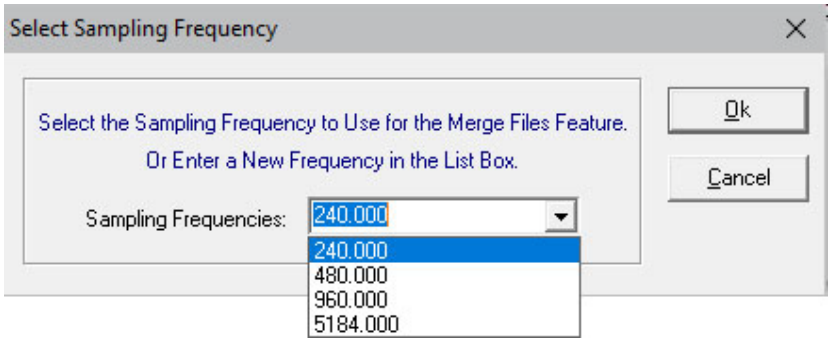


Figure 2.24 Merge Waveform Files: Select Frequency

If the merged files have different data types (RMS Calibrated or Peak Values) then the RMS values will be converted to Peak values by multiplying the RMS values by Root 2.

To identify the merged channels the station name for each file is added to the beginning of the analog and digital channel names. To turn this feature off open the Properties dialog  in the analysis window. Click on the Append/Merge tab and uncheck the Add the File's Station Name to Beginning of the Analog/Digital Channels field.

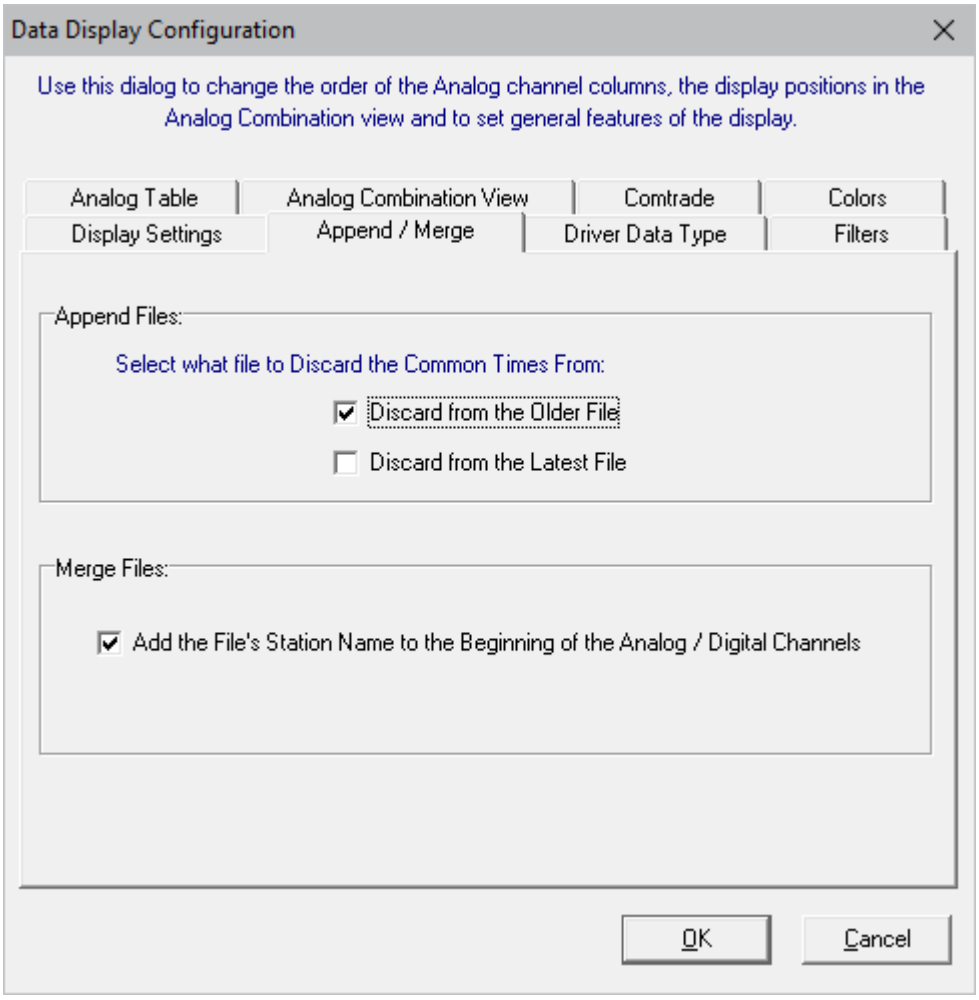


Figure 2.25 Append/Merge Properties

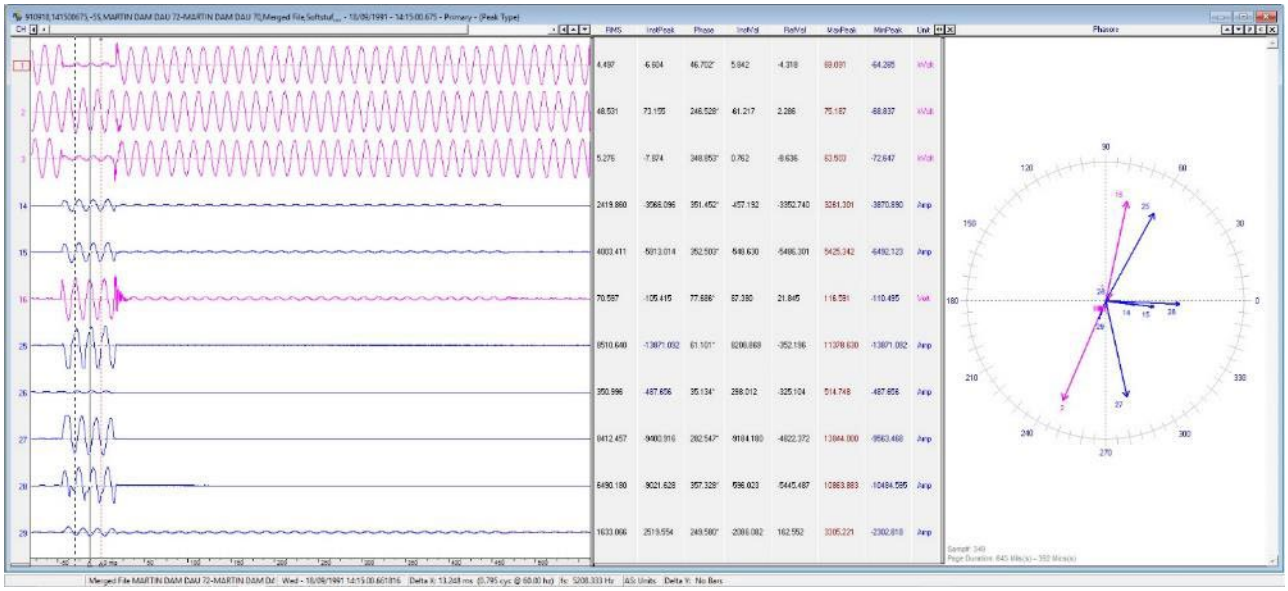


Figure 2.26 Merge Waveform Files By Time

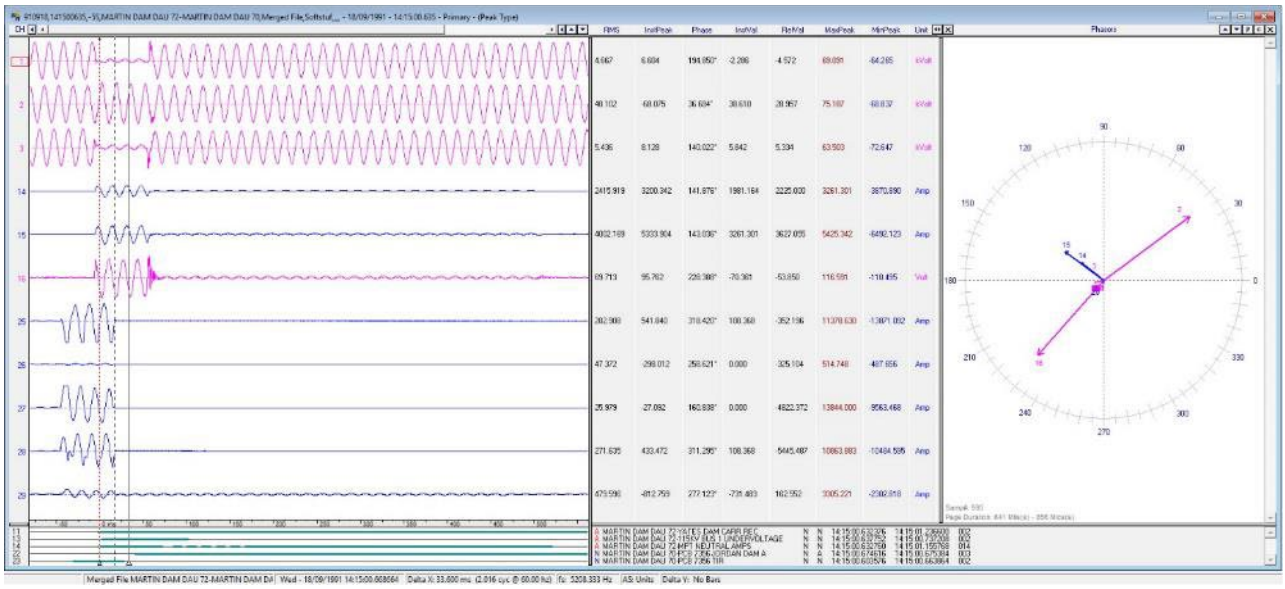


Figure 2.27 Merge Waveform Files By Sample

FILE REPORTS

GENERATING CALIBRATION REPORTS

The Calibration report list the Maximum and Minimum analog summary information for the marked files. Calibration reports should only be generated on files that contain no fault data such as snapshot files. To generate a report, mark the desired files and select the Calibrate icon under the Options tab. Refer to the “Summary” section for field descriptors. The report information is saved in the DVREPORT.DTB file located in the Wavewin directory.

GENERATING SEQUENCE OF EVENTS (SOE) REPORTS

To generate a table of sequence of events from multiple waveform files, mark all of the desired files then press F11 or Select the SOE List icon under the Options/Reports tab. A table listing all of the events triggered in the selected files is displayed. The table is sorted according to date and time. The columns listed in the table include:

State: The state on the event/sensor at the displayed date and time (A=Abnormal, N=Normal).
Trigger Date: The date the event/sensor triggered or cleared.
Trigger Time: The time the event/sensor triggered or cleared.
Chan: The channel number of the event/sensors in the file from which it was read.
Channel Title: The channel title of the event/sensors.
Device: The device from which the event/sensors originated.
Substation: The substation from which the event/sensors originated.
File: The filename from which the event/sensors originated.

The Query section at the bottom of the table allows for searching events from specific substations, devices, and channels. To plot the specific events press <enter> or double click on the event.

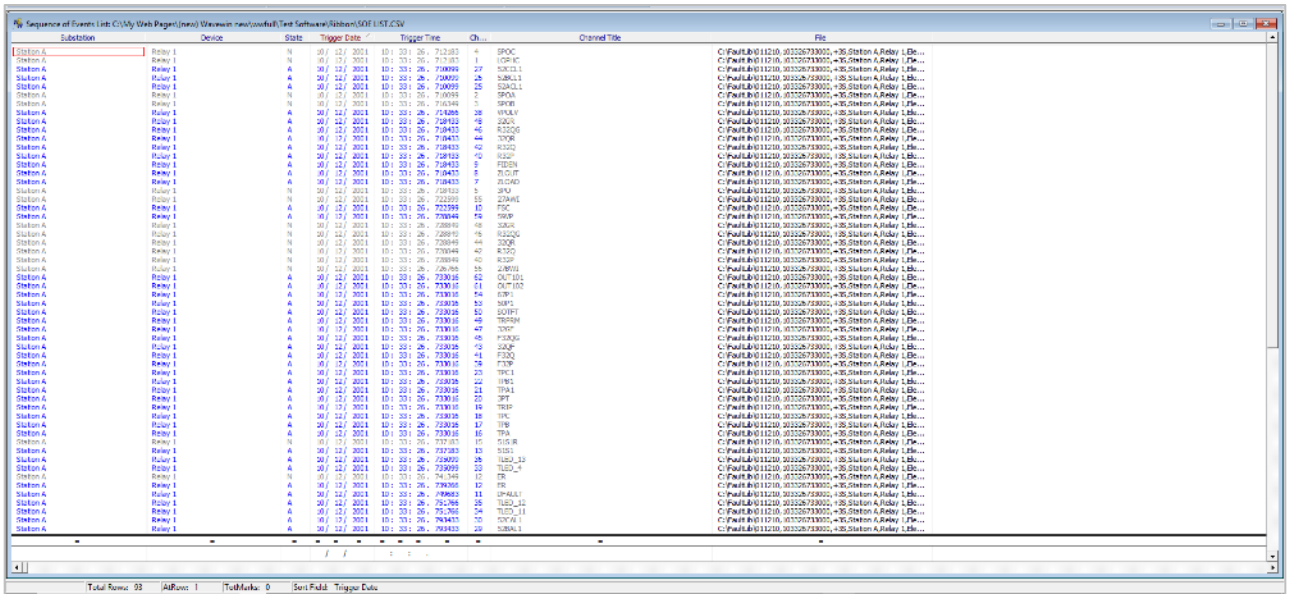


Figure 2.28 SOE List

GENERATING SEQUENCE OF EVENTS (SOE) SUMMARIES

To generate a summary of the sequence of events for multiple waveform files, mark all the desired files then Select the SOE Summary icon under the Options/Reports tab. A table listing a summary of all the events triggered in the selected files is displayed. The table is sorted according to date and time. The columns listed in the table include:

Substation: The substation that triggered the event/sensor.
Device: The device that triggered the event/sensor.
Fst-State: State the channel started at, A=alarm and N=normal.
Lst-State: State the channel ended at, A=alarm and N=normal.
Fst-Change Date: Date the channel first changed state.
Fst-Change Time: Time the channel first changed state.
Lst-Change Date: Date the channel last changed state.
Lst-Change Time: Time the channel last changed state.
Changes: Number of times the channel changed state.
Chan #: Channel number in the file.
Channel Title: The channel title of the event/sensor.
File: The filename from which the event/sensors originated.

The Query section at the bottom of the table allows for searching events from specific substations, devices, and channels. To plot the specific events press <enter> or double click on the event.

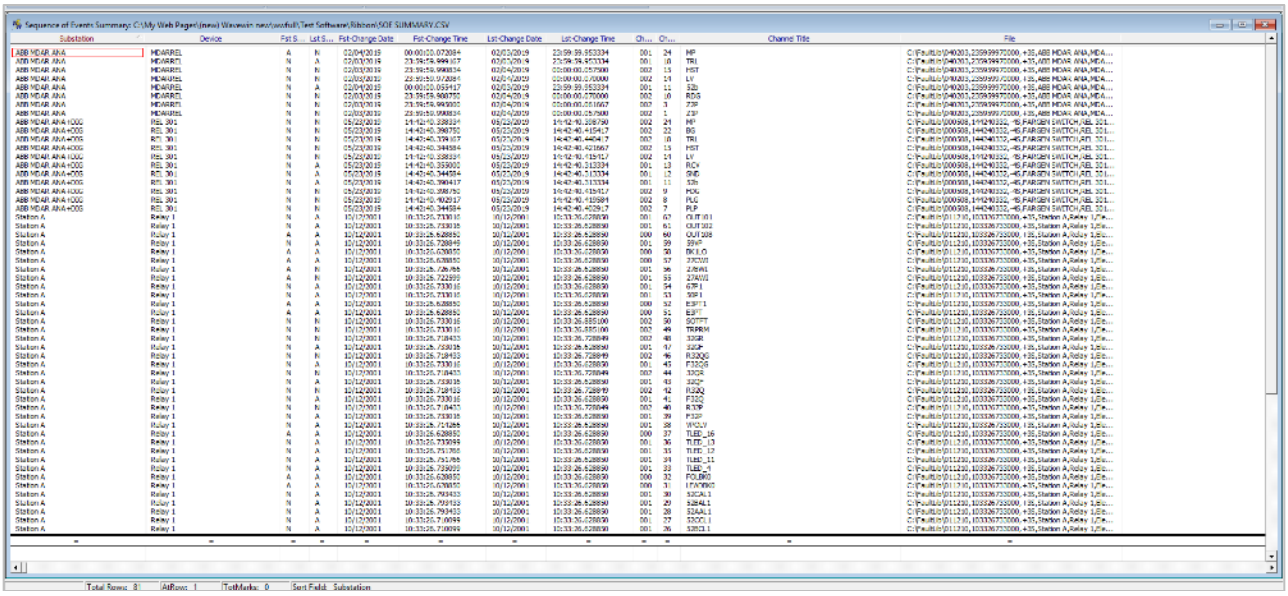


Figure 2.29 SOE Summary

VIEWING ASCII FILES IN DATABASE FORMAT

The database viewer provides an effective way to organize, sort, and search comma delimited, double quoted comma delimited, or tab delimited text files. The data is presented in tabular form, and an unlimited number of rows and columns can be displayed. The viewer allows for intelligent queries, column sorting, selecting, and grouping data, row deletion, printing, saving, and saving in a new file.

Use the column headers to sort the data in ascending or descending order and the query fields to search the data. Refer to the Querying Files section for more information. To browse the data, use the up, down, right, left, page-up, page-down, home, end, ctrl+home, and ctrl+end keys or use the scroll bars. Rows must be marked to delete them from the table.

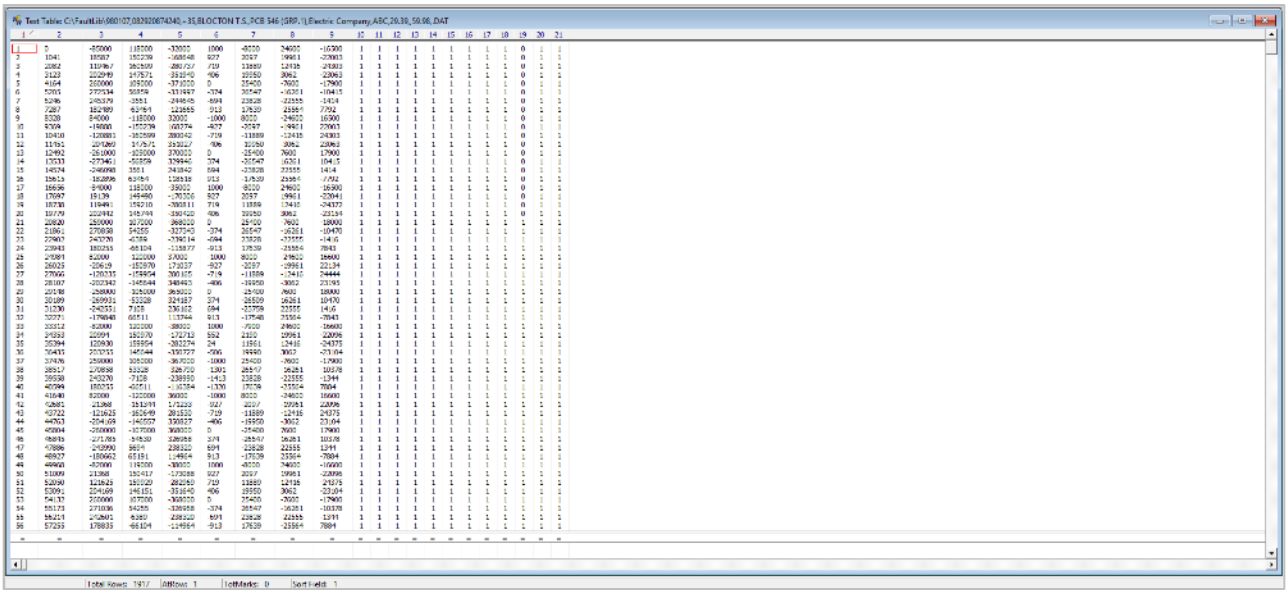


Figure 2.30 Database Viewer

SHOW/HIDE CHANNEL TITLES

The data plotting window automatically hides channels that contain certain characters in the channel title. Below is a list of the characters defined as invalid channels when a file is displayed.

- UNUSE
- UNDEF
- NOT D
- NOT U
- NOT I
- NOT A
- {
- N/A
- ANALOG INPUT
- UNTITLED
- ANALOG CHANNEL
- EXTERNAL INPUT
- EVENT CHANNEL
- CHANNEL:
- DIGITAL TRACE #
- SPARE

If a channel title contains the above characters in the beginning of an analog or digital channel title the channel is automatically hidden. These characters can be modified to show a channel when a file is displayed. To show a title that contains the above characters select the Show/Hide Titles icon under the Options tab.

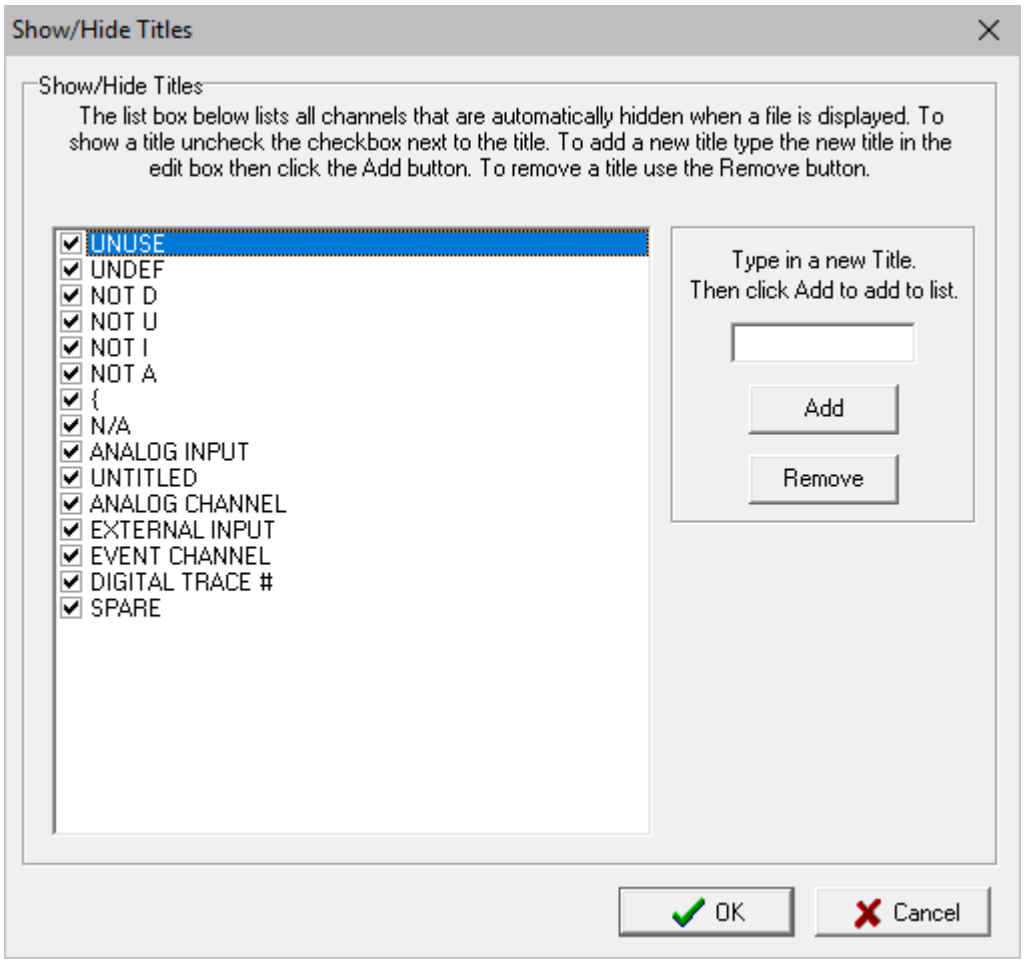


Figure 2.31 Show/Hide Channel Titles Dialog

To show a title, uncheck the checkbox next to the displayed invalid channel title. To remove a title from the list, select the title in the list box then click the Remove button or press the delete key. To add a new title, first type the new title in the edit box then click the Add button. The new title is added to the end of the list with the checkbox automatically checked.

QUERYING FILES

The query fields are used to search for specific information in the table. Query fields are located below the table. Use the tab key to move the cursor from the table to the query fields and up arrow to return to the table. The Ctrl-left/right keys move the edit box between the query fields. Each field contains an input and an operator. The inputs are directly entered from the keyboard and may include the “*” and “?” wild cards. Operators are located above the input fields and can be changed by clicking the mouse button on the operator symbol or by pressing the F9 key. The selectable options include equal to (=), less than (<), and greater than (<).

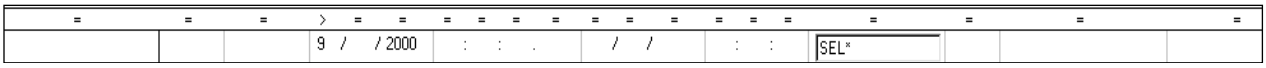


Figure 2.32 Query Fields

When a query is launched, the engine numerically compares the input with the information in the table. If numerical comparison is not possible, symbolic comparison is performed. When multiple fields are

defined, the engine searches for a match on the first field “AND” on the second field “AND” on the third field and so on.

Three query options are available: Query All Files, Query Marked Files, or Query Unmarked Files. Files that meet the specified query requirements are marked, grouped, and displayed at the top of the table. Use the Ctrl-left/right keys to navigate through the query fields and the <enter> key to process the query.

DISTURBANCE REPORT

The disturbance report feature creates a comma delimited file that contains the following information for each file processed (if available in the file):

- Utility Name,
- Device Name (Fault),
- File Start Date & Time,
- Substation Name,
- Report Date,
- Faulted Phase,
- Fault Location,
- Line Length,
- Fault Current,
- Maximum Voltage,
- Maximum Frequency,
- Minimum Frequency,
- Pass/Fail,
- Passed Filters and the
- Source file's folder and filename.

The disturbance report dialog allows for setting the report's destination folder and filename. It also allows for setting the folder(s) where the event files are located. The filter section is for setting filter levels for the Faulted Phase, Fault Location, Current and Voltage thresholds, and the deviation for the frequency.

To open the disturbance report dialog, select the Disturbance icon under the Options tab. **The disturbance report is only available in the Wavewin Universal Viewer and Wavewin Full Version.**

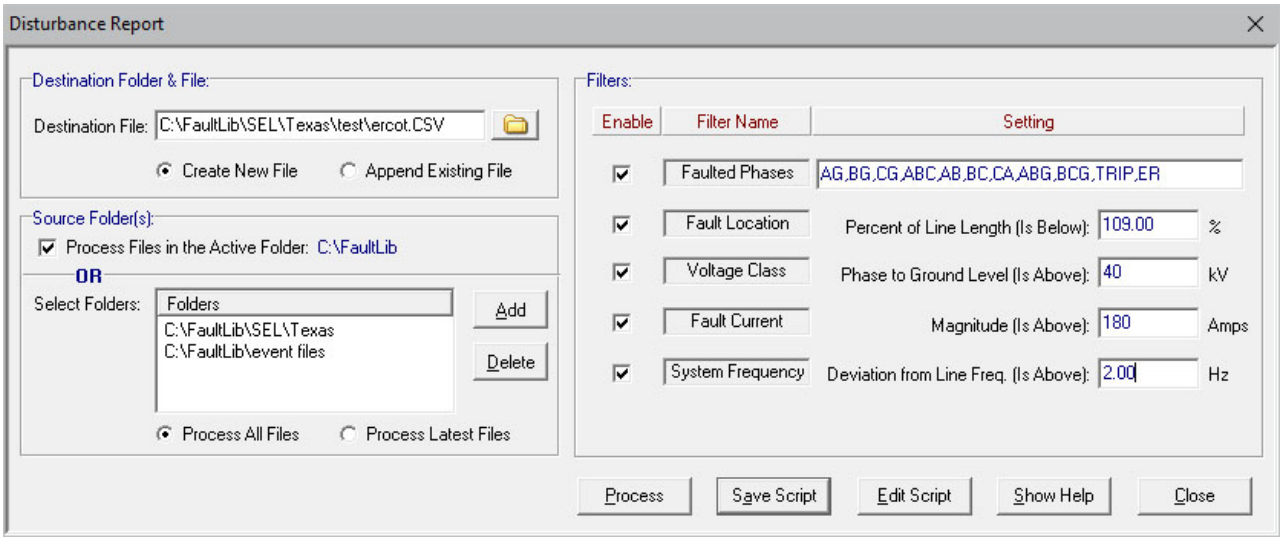


Figure 2.33 Disturbance Report Dialog

The disturbance dialog has 3 sections: Destination Folder & File, Source Folder(s), and Filters. Each section is explained in the following sections along with the functions for each button.

DESTINATION FOLDER & FILE:
The Destination Folder & File section is used to set the disturbance report folder & filename. Type the drive, folder and filename into the Destination File field or use the Browse button to locate an existing file or for creating a new file and/or folder.

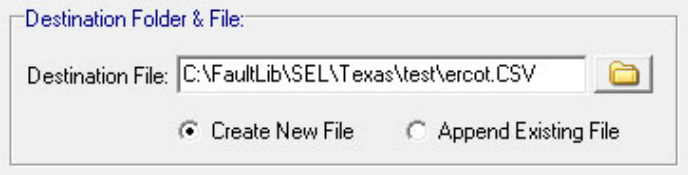


Figure 2.34 Disturbance Report: Destination Folder & File

To save the disturbance information to a new file, click the Create New File radio button. This option will clear the file before processing the event files. To append the disturbance information to the end of an existing file, click the Append Existing File radio button.

FOLDERS:
The Folders section is used for defining where the event files are located. To process files located in the File Manager's active folder check the Process Files in the Active Folder check box. If files are marked in the active folder, then this feature will process only the marked event files. If there are no marked files, then all the event files are processed.

If the event files are in different folders, then use the Add button to add a folder to the Source Folder list. To remove a folder from the list, use the Delete button.

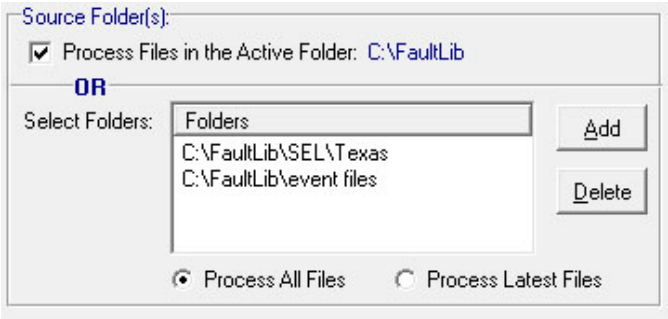


Figure 2.35 Disturbance Report: Source Folder(s)

FILTERS:
The Filters section is used to define the faulted phases, the filter levels for the fault location, voltage class and fault current levels. It also defines the deviation of the maximum and minimum frequency values from the Line Frequency.

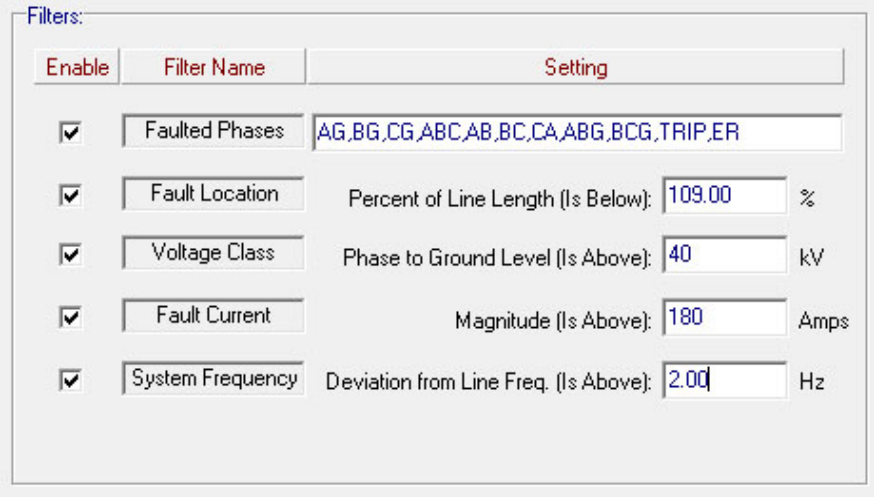


Figure 2.36 Disturbance Report: Filters

After the filters are applied to the data file the file will be tagged with PASS or FAIL. A PASS means that the file's fault type exists in the list AND the fault location is within the entered percentage of the line length AND the fault current is above the entered fault current value AND the voltage class is above the entered voltage class value OR the maximum or minimum frequency is above the entered deviation from the line frequency. The calculations used are listed below:

For files with no Voltage Channels a PASS Equals:
Faulted Phase is in the List of Filter Phase Settings
AND
Maximum Fault Current is > Entered Fault Current Filter
OR
|Maximum/Minimum Frequency Value - Line Frequency| is > Entered Filter Deviation Value

For files with Voltage Channels a PASS Equals:
Faulted Phase is in the List of Filter Phase Settings
AND
Fault Location is < Entered % of the Line Length
AND
Maximum Voltage Value is > Entered Voltage Class Filter
AND
Maximum Fault Current is > Entered Fault Current Filter
OR
|Maximum/Minimum Frequency Value - Line Frequency| is > Enter Filter Deviation Value

Each file in the report also lists the filters that triggered. The 5 columns to the right of the PASS/FAIL column list the filters that triggered. Each column is labeled according to the filter:
P = Faulted Phase Filter
L = Fault Location Filter
C = Current Filter
V = Voltage Filter
F = Frequency Filter

If a filter triggers, then the filter letter is displayed in the columns otherwise it is left blank.

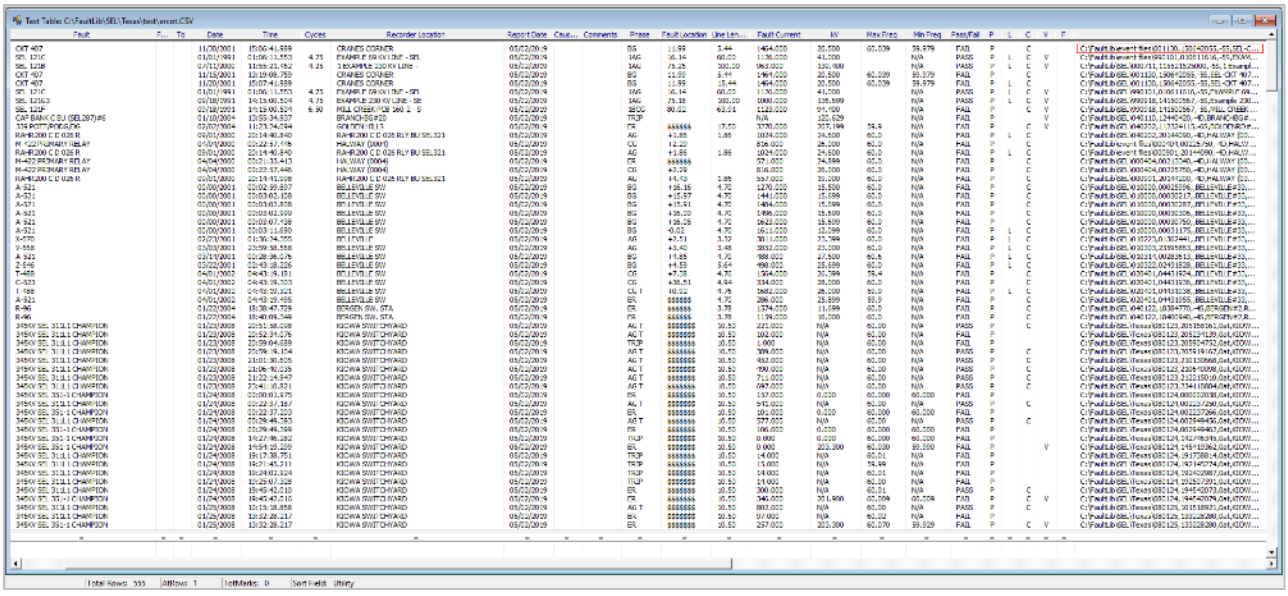


Figure 2.37 Disturbance Report

The Process button starts the disturbance report. Once started the Disturbance dialog is closed and each file is processed. The progress bar displayed in the button speed bar is updated according to the number of files to process and the current file being processed.

When the processing is complete a comma delimited table is displayed. The comma delimited table allows for sorting each column by clicking on the column's header. The query section located below the table allows for quick searches for specific files. Also, the processed files can be displayed by double clicking on a row or moving the table cursor to the row and pressing enter. The file will be displayed in the analysis window.

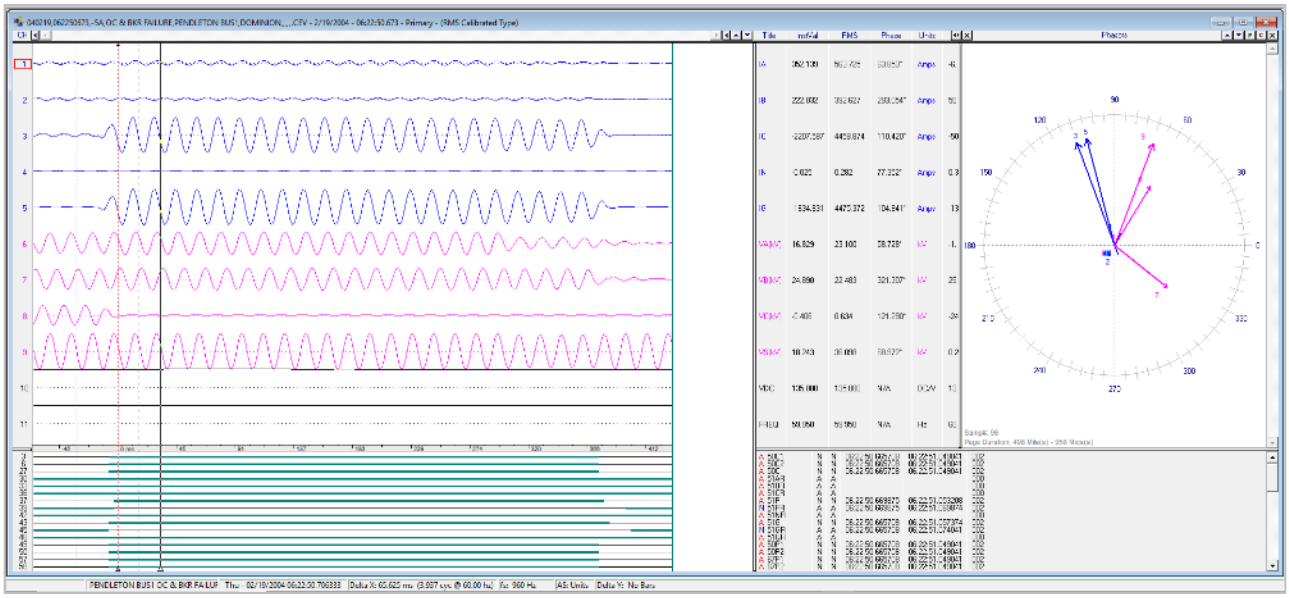


Figure 2.38 Disturbance Display File

BUTTONS:
There are 5 buttons displayed at the bottom of the disturbance dialog. Each button is explained in the following table:

1. **Process Button:** The process button starts the disturbance report. The dialog is closed, and each file is processed. The progress bar displayed in the button speed bar is updated according to the number of files to process and what file is currently being processed.

2. **Save Script:** All the information displayed in the dialog is saved in a script file located in the folder where Wavewin is located. The file is called: Disturbance.ini. A message box is displayed confirming that the information has been saved. The dialog information is also saved to the Disturbance.ini file when the “Process” button is clicked.

3. **Edit Script:** The edit script button closes the dialog and displays the Disturbance.ini file in the ASCII editor.

4. **Show Help:** The show help button displays the help information in a note pad below the buttons. The window size is increased to show the note pad. When the help window is displayed the Show Help button’s text changes to Hide Help. To hide the help window, click on Hide Help.

5. **Close:** Close the dialog without saving the entered information.

COMPLEX CALCULATOR

The complex calculator is used to perform complex mathematical operations. Operations can be performed in Polar or Rectangular form. Also, there are 4 memory locations used to store the results of an operation. To store a result first click on the memory location radio button then click on the down arrow next to the Magnitude edit box. To recall a memory location, click on the memory locations radio button then click on the Recall button. The Clear All button clears all four memory locations.

The calculator operates as an HP calculator. After each entry click the “Enter” button to record the values in the Accumulator.

The calculator icon is in the Files tab in the File Manager and in the Data tab in the Analysis window.

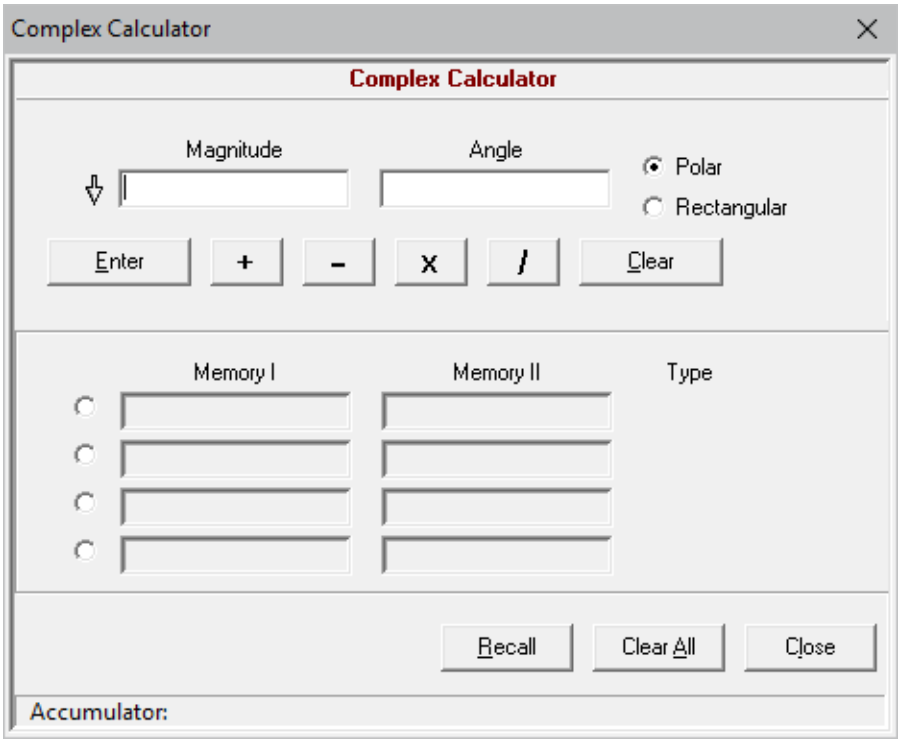


Figure 2.39 Complex Calculator

AUTO CONVERT TO COMTRADE

The auto convert to Comtrade dialog is used for defining the properties to automatically convert specific file types to the IEEE C37.111 Comtrade format. To specify the Comtrade format the files will be saved in, select from the Save As Type drop down list. To save the SEL settings from the original files check the Save SEL Settings checkbox. The SEL setting is saved to the Comtrade's Header .HDR file/section.

Auto Convert to Comtrade monitors the entered "Source Path" for the defined file extensions. When a file is detected, it first saves the output Comtrade file to the defined "Destination Path" then archives the source file to the defined "Archive Path".

The SEL Sag/Swell/Interruption (SSI) files contain multiple event information stored with big gaps of time between each event. These files will be scanned for events and each event will be saved in a separate Comtrade file. To define the boundaries for the SSI files, enter then minimum number of cycles required before saving to Comtrade, the default is 2 cycles. Also, enter the maximum number of milliseconds between samples before the SSI data is separated into multiple Comtrade files, the default is 50 milliseconds.

To open the Auto Convert to Comtrade dialog select the Auto Convert icon under the Options tab in the File Manager. Enter the source path, destination path, archive path, file extensions separated by commas and the scan period in minutes. Auto convert to Comtrade monitors the Source path for the defined file extensions every scan period.

To start the process, click on the Start Convert button. Once the conversion starts the button caption will change to End Convert. To end the conversion process, click on the End Convert button. If a file already exists in the destination path, then the file is overwritten. The status of each scan is displayed in the Status section of the dialog.

To have the auto convert to Comtrade process started when Wavewin is ran check the Automatically Start Convert to Comtrade at Run Time check box. The conversion process is performed in the background. The dialog is not required to be open for the process to execute. To check the status of the conversion, open the dialog. The Next Scan In field reports how many minutes before the next scan is started.

Inputs:

Field	Definition
Properties:	
Source Path	Path where the original files are located.
Include Sub-Folders	Scan all sub-folders under the Source path.
Destination Path	Path where the converted Comtrade files are saved.
Automatically Rename	Automatically rename all converted Comtrade files to the IEEE long file naming format.
Archive Path	Path where the original files are archived after they are converted to Comtrade.
File Extensions	The extension of the files to convert to Comtrade separated by commas, *.SSI,*.EVE
Scan Period	The scan period in minutes.
Save As Type	Select the type of Comtrade format to save the original file in.
Save the SEL Settings	Save the SEL setting information in the original file to the Comtrade's header file/section.
SEL SSI Files	
Minimum # of Cycles	The minimum number of cycles required before saving to Comtrade.
Milliseconds Difference	The maximum number of milliseconds between samples before the SSI data is separated into multiple Comtrade files.

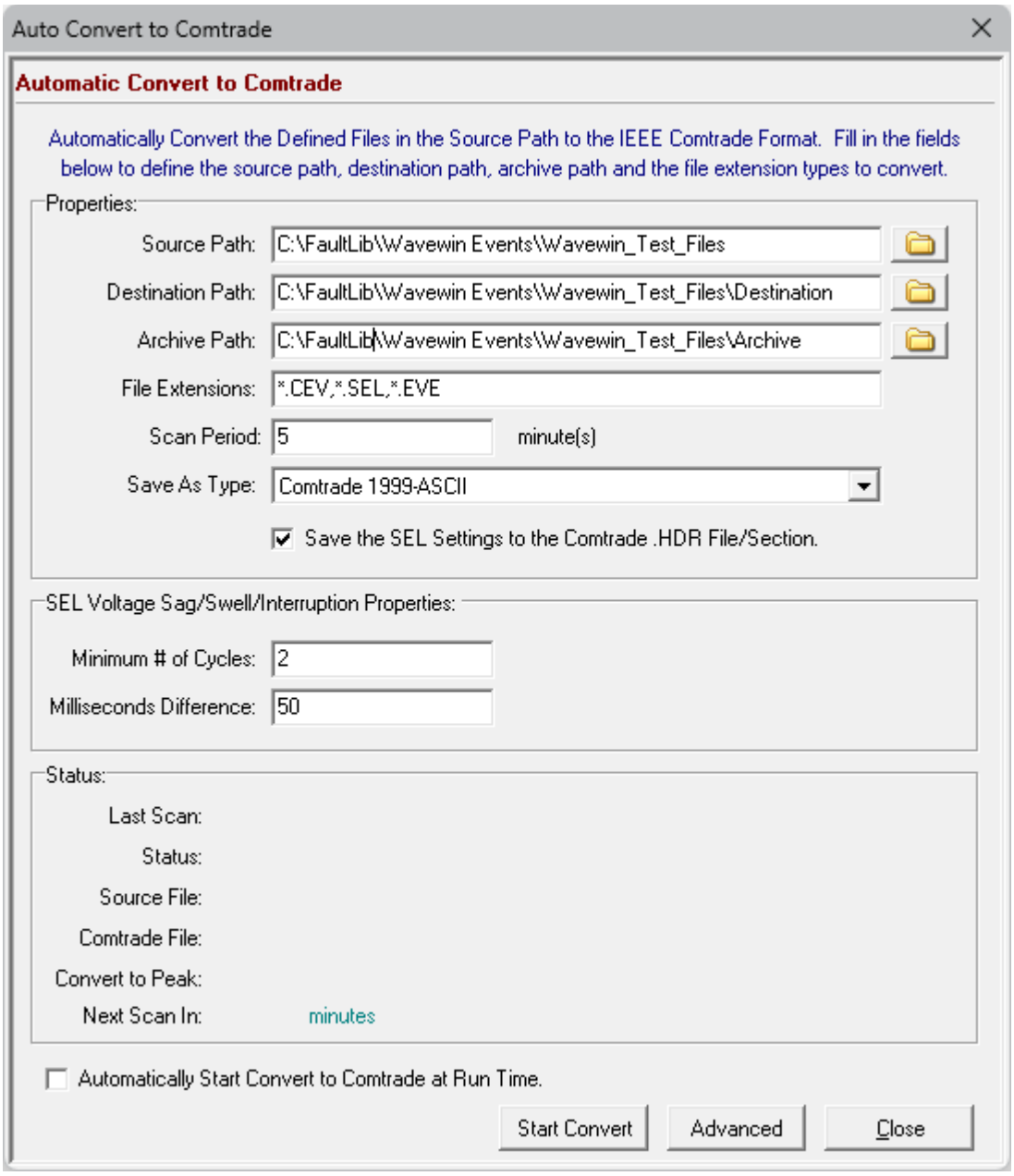


Figure 2.40 Auto Convert To Comtrade

SHORTCUTS

For easy access to the tab options in the file manager and data plotting window a shortcut drop-down menu button can be configured from the Shortcuts dialog. To open the Shortcuts dialog, open the Display dialog from the File Manager's Options tab. Click the Shortcuts button.

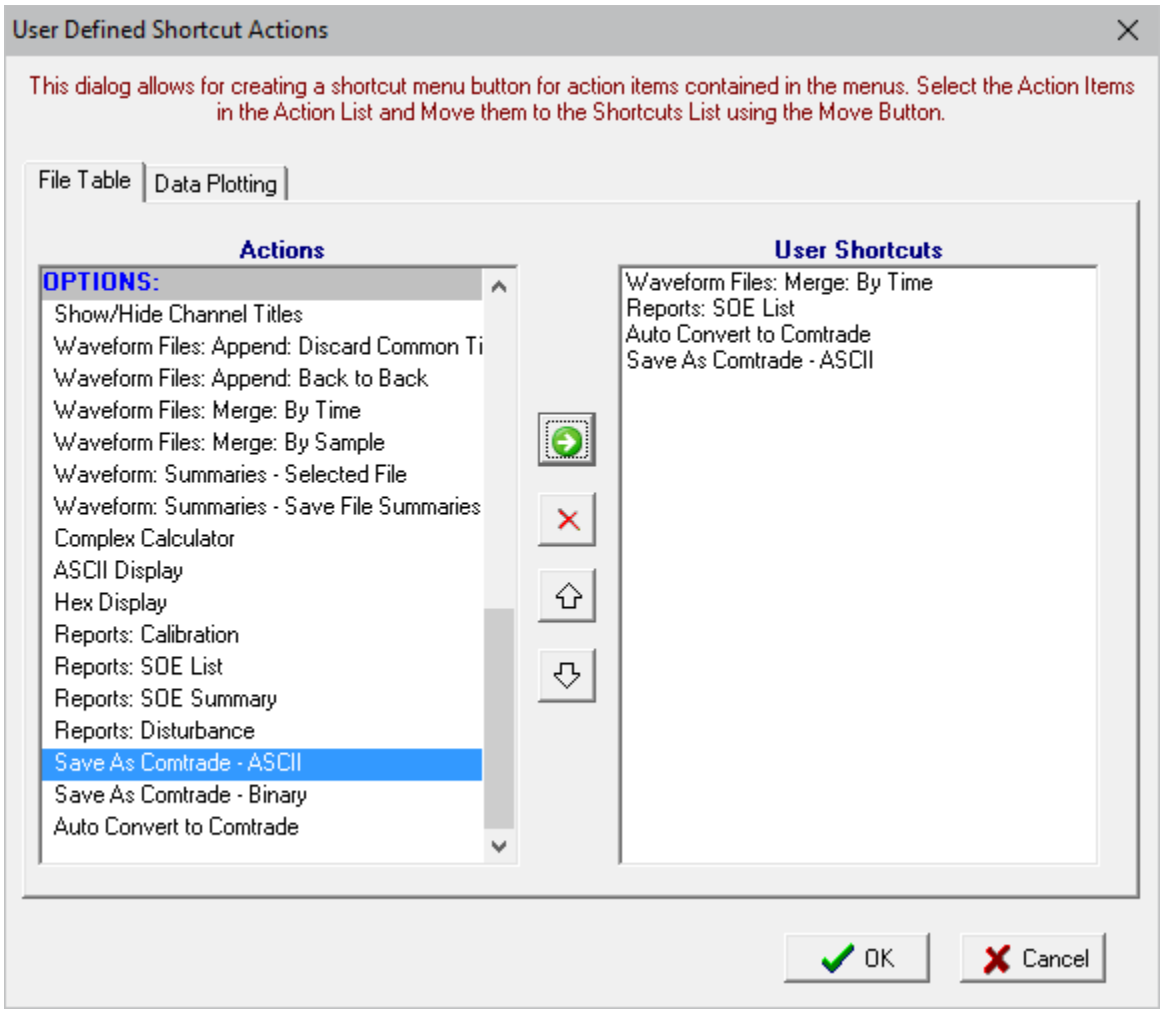


Figure 2.41 ShortCut Dialog

There are two tabs, one for the file manager and one for the data plotting window. Click on the tab to define the shortcuts. Select the tab items using the Ctrl-default mouse button then click the green Move button. All selected tab items will be copied to the User Shortcuts list. To delete tab items from the User Shortcuts list, select the item and click the “Delete” button.

To arrange the shortcuts, select the item and click the Move Up or Move Down buttons. Click OK to save the shortcuts or Cancel to abort the changes.

When the shortcuts are saved a new drop-down menu button is added to the appropriate menu bar.

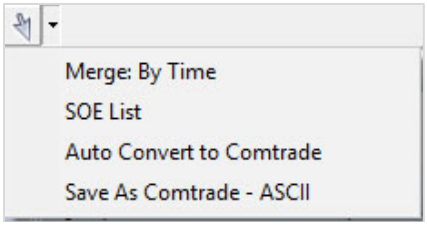


Figure 2.42 ShortCut Menu

SEARCH FILE CONTENTS

The Search File Contents dialog allows for searching ASCII files for key words and displaying the results in a table format. To open the dialog, select the Search icon under the Files tab/menu.

This dialog allows for selecting the Start Date, End Date, Search Path, the file extensions to search, the key strings to search for and the path where the results will be saved. Refer to the following table for more details on each field:

Field	Definition
Start Date:	Select the Month Day and Year from the Start Date drop down list boxes. This defines what files to search in the the defined Search Path and Included Sub Folder if specified. If the files save date is equal to or greater than the selected start date and less then or equal to the selected end date then that file is searched for the entered search strings.
End Date:	Select the Month Day and Year from the End Date drop down list boxes.
Search Path:	Enter the Search Path or use the Browse button to the select the path.
Include Sub Folders:	To include all sub folders under the Search Path click the Include Sub Folder check box.
Extensions:	Enter the file extensions to search separated by commas, for example: *.DTB,*.TXT,*.CSV.
Search Strings:	Enter the search string to look for. For multiple search strings separate each string by a comma, for example: password, logon.
Report Path::	Enter the Report Path or use the Browse button to the select the path.

The Start Date and End Date define what files to search. If a file's save date is within the start and end dates, then that file is included in the search.

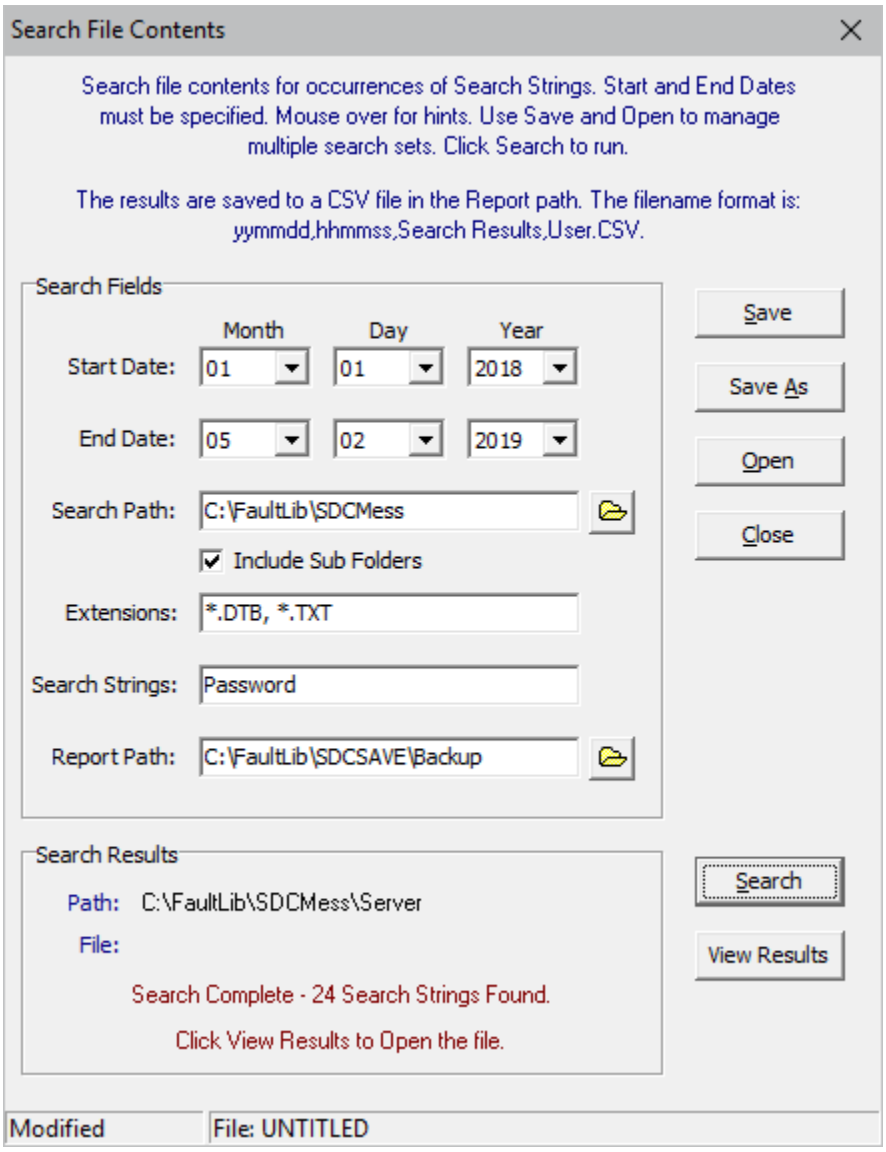


Figure 2.43 Search File Contents Dialog

The dialog also allows for saving the search fields to an ASCII txt file and for opening existing search files. Use the Save, Save As and Open buttons to save the active search to the active file listed in the status field, save the search fields under a new file name or for opening an existing search file. The search fields are saved to the ASCII text file in an INI file format:

```
[START DATE]
01\01\2016
[END DATE]
01\01\2020
[SEARCH PATH]
C:\FaultLib\SDCMess
[INCLUDE SUBFOLDERS]
1
[SEARCH FILES]
*.DTB
[SEARCH STRING]
```

password
[REPORT PATH]
C:\FaultLib\SDCMess\Backup

To start the search, click the Search button. If results are found then the results are saved to a CSV file with the following file name: yymmdd,hhmmss,Search Results.CSV.

The Search Results status window section displays the search path, each file being searched, and the number of search items found.

To view the search results, click the View Results button. A table is displayed with the following columns:

Field	Definition
Occurance	The occurance number in the listed filename.
File Date	The save date of the file.
File Time	The save time of the file.
Search String	The search string found.
Line Number	The line number where the search string was found in the file.
Line Text:	The text of the line number number.
FileName:	The path and filename where the search string exists.

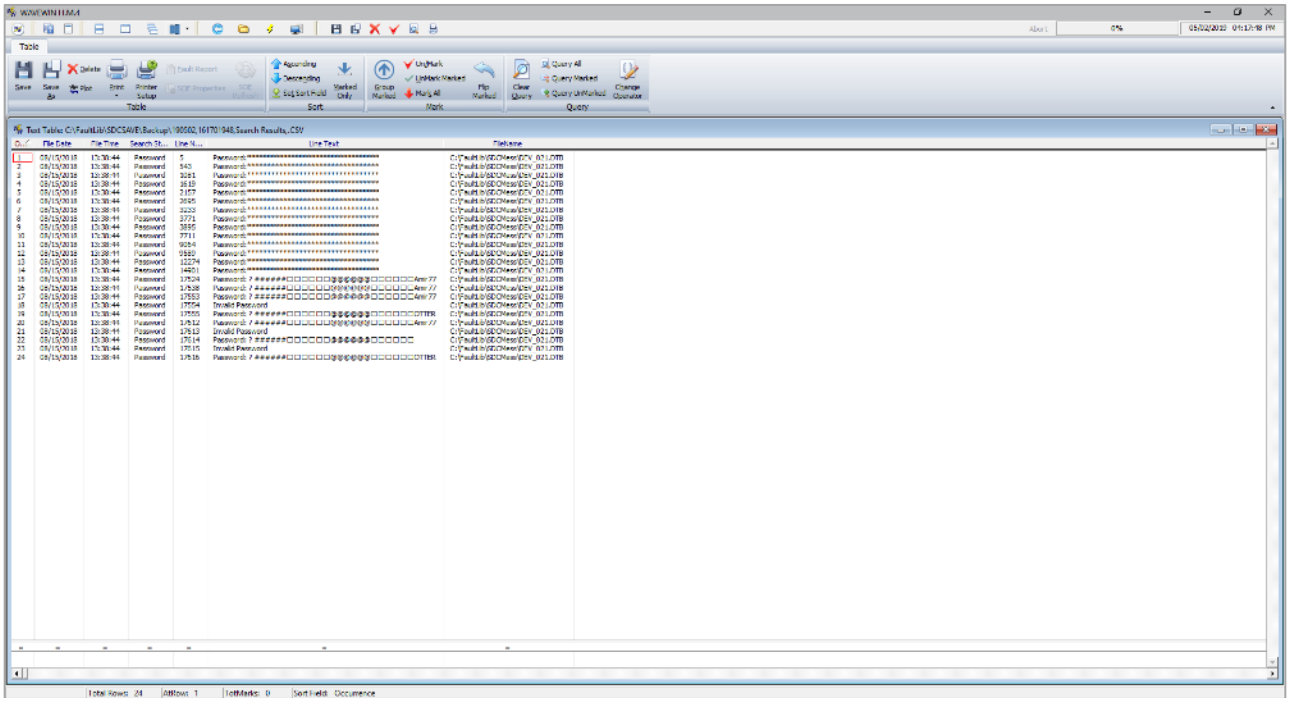


Figure 2.44 Search File Results

To view the file and line number of the search results double click on the table row of the desired search item. The file will be displayed in an ASCII editor at the specified line number.

AUTO PROCESS TEMPLATES

The Auto Process Templates dialog allows for automatically extracting key information from waveform files and saving the extracted information to a comma separated ASCII file with a .DIG extension. The .DIG file can then be imported into a database.

The Auto Process Templates feature is only available in the Wavewin Universal Viewer and Wavewin Full Version.

The template files contain script commands that will perform calculations on the voltage and current channels. For the calculations to work properly the analog channels must be in the right position. For this, line groups are created. The line groups ensure that the voltage channels (VA, VB, VC) are the first 3 channels displayed and the next 4 are the current channels (IA, IB, IC, IN).

A line group file is created for each specific device. The name of the line group file is composed from the first line in the Comtrade .CFG file. The line group file has a .LNG extension. In the Comtrade standard (C37.111) the definition of the first line in the CFG file is defined below:

Station name, identification of the recording device, and COMTRADE Standard revision year

The line group file name can be named using the first field in the CFG file or a combination of the first and second fields separated by a comma. For example, if a device saves the .CFG files with “MyStation” as the first field and “MyDevice” in the second field on the first line then the line group file will be MyStation.LNG or MyStation,MyDevice.LNG. The system first looks for the line group file with the first field name, if that is not found it looks for a combination of the first and second.

To create a line group file for each Comtrade file being processed use the versioning option inside the File Manager’s display dialog. When Comtrade files are extracted from the device a new file is created with the same name as the .CFG and .DAT but with the extension LGP. The LGP is a copy of the LNG file but named to be associated with the Comtrade file. This allows for a versioning system. It preserves the line group information for past Comtrade files. To activate the versioning system, open the Display dialog under the Options tab in the File Manager. Select the Data Plotting tab. Under the Process File group select Yes from the Versioning field’s drop-down list.

The Auto Process Template will monitor a path, and all sub-directories, is specified, for new files to process. There are two ways new files can be processed, By Save Date or by adding a WWD to the end of the file name. To define the processing type, open the Display dialog under the Options tab in the File Manager. Select the Data Plotting tab. Under the Process File group select Rename with WWD or By Save Date from the Process Type field’s drop-down list. The field to the right of the Process Type field will change according to the selected type. If By Save Date is selected the field to the right will be Start DT. This field displays the last file’s date and time that was processed. If no files have been processed yet, it’s default date and time is 01/01/1970 00:00:00. To start at a specific date and time enter the desired date and time.

If renamed with WWD is selected the field to the right will be Batch Files. This field allows for selecting what files will be processed in the directories, All the files or just the new files. New files are any file that does not have a ,WWD in the last field of the filename.

The Process File section in the Display dialog allows for defining several fields for customizing the auto process template feature. Each field is defined below.

Field	Definition
Process Type	Select how the files are processed, By Save Date or by renaming a processed file by adding a ,WWD at the end of the filename. If Rename is selected the next field will be Batch Files. If Save Date is selected the next field is Start DT
Batch Files	Select the type of files to process, All files or New Files. New files will only process files that do not have a WWD added to the end of the name.
Start DT	Defines the start date and time for processing new files.
Versioning	Create a line group version file for each waveform file processed. The line group is named the same name as the processed file with a .LGP extension.
Process #	Select the number of files to Process during each run. The default is 256.

Field	Definition
PDF Files	Create a PDF file for the processed line group. There are 4 options to selected from: All Files: Create a PDF file for each line group processed. No Files: Do not create PDF files. Breaker Opt & Fault Type: Only create PDF files for lines that had a breaker operate and a fault type exists. Fault Type: Only create PDF files for lines that have a fault type.
Convert DT to Local	Convert all Date and Times in the final DIG file from UTC to local time.
PDF Width	Defines the width of the PDF document.
PDF Height	Defines the height of the PDF document.
Delete After	Delete the after it has been processed.
Delete No Line Group	Delete files that have no line groups defined.
Rename After	Rename the processed DIG file to a long filename before processing the next batch of files.
Time Code	The time code used when renmaing the DIG file.
Station	The station name used when renmaing the DIG file.
Device	The device name used when renmaing the DIG file.
Set Data Bar	When processsing files the data bar is postioned in the fault area. The data bar can be positioned a number of cycles from the files trigger position or from the systems calculated trigger time.
# Cycles from Bar	Position the data bar froma number of cycles from the selected trigger position. The options are 1, 1.2, 1,75 or 2 cycles.
Move Files	The Move Files with no Line Groups to the sub-folder No-LineGroups field will move any files that do not have line groups associated with them to a sub-folder named No-LineGroups if Yes is selected from the drop-down options. All associated files to the data file will also be moved.

The next two sections (Line Group and Templates) explain how to create line groups and template files. These are the two main items needed to successfully process waveform files.

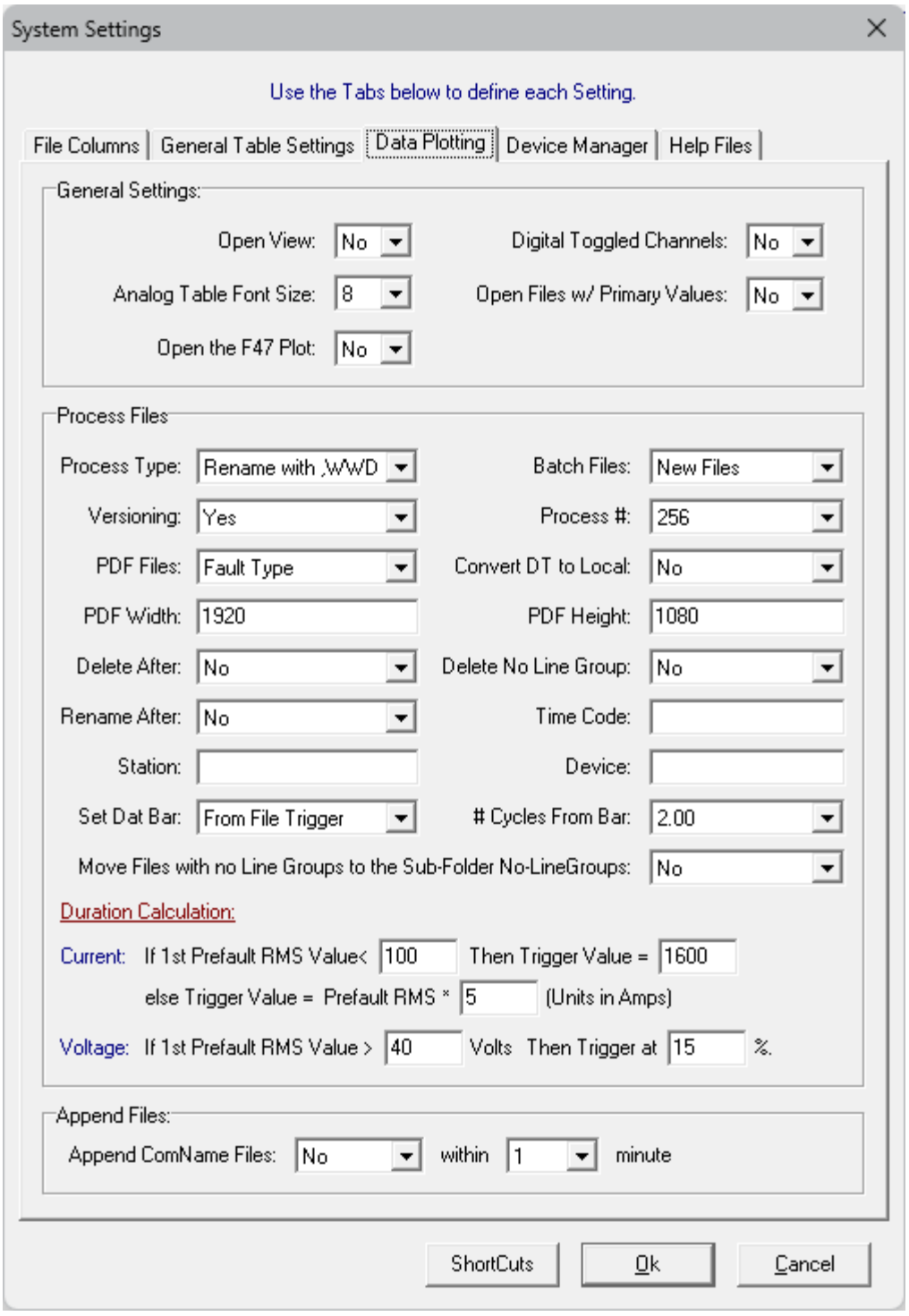


Figure 2.45 Auto Process Templates Properties

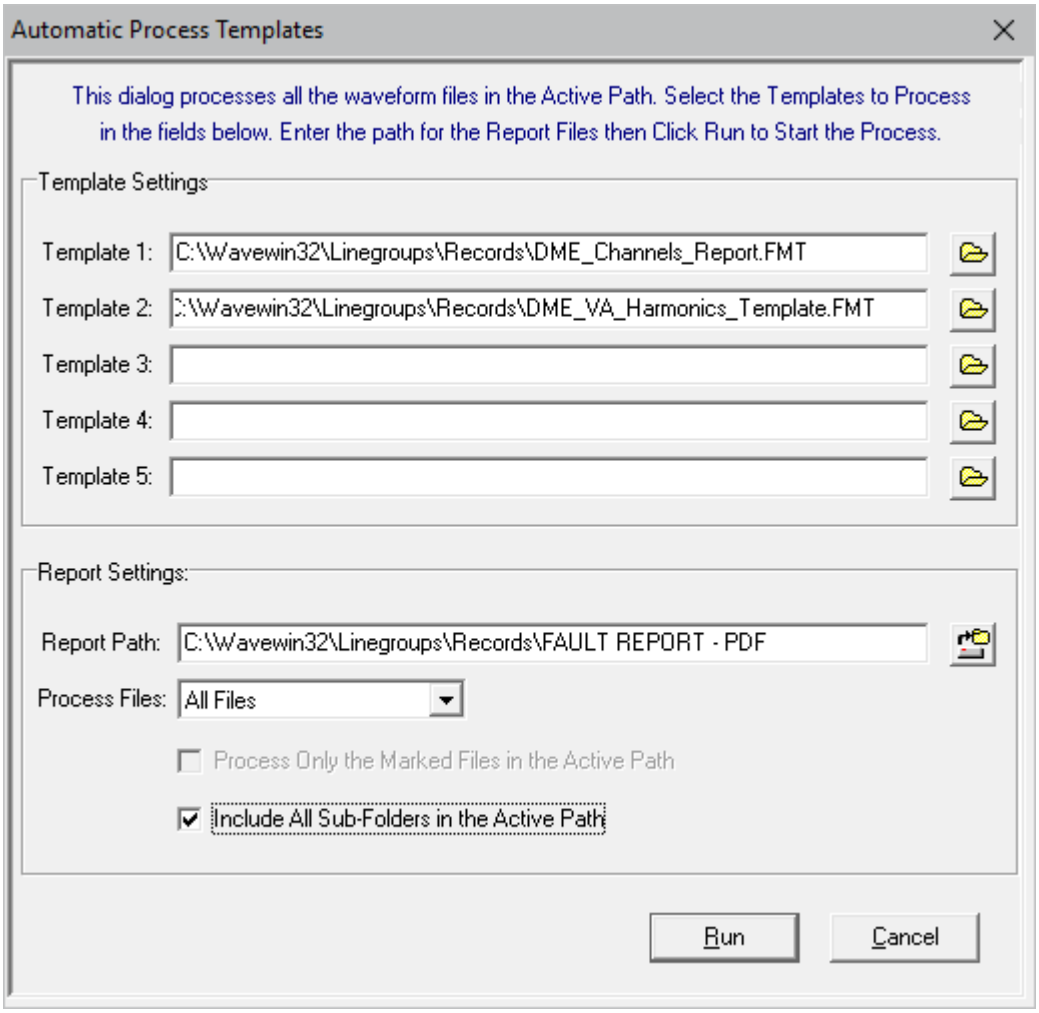


Figure 2.46 Auto Process Templates Dialog

LINE GROUPS

A Line Group defines all the information needed to view and analyze (manually or automatically) the data for a specific feeder from an installed DME or Relays. The information includes analog channels, associated breakers and other digital events, remote end, and line impedance information.

The line group file contains the following information:

[S-D456]
LineName=S-D456
RemoteDME=Bainbrook 345kv
RemoteName=S-E567
RemoteDevice=DFR Unit 1 South Station
VaChan=22
VbChan=23
VcChan=24
IaChan=25
IbChan=26
IcChan=27
InChan=28

Breaker1=1
Breaker2=2
Event1=14
Event2=15
Event3=16
Event4=17
Event5=18
Event6=19
Event7=20
Event8=21
Event9=22
Event10=83
Event11=84
Event12=85
Event13=86
Event14=87
Event15=88
Event16=89
Event17=90
Event18=91
VaColor=Red
VbColor=Blue
VcColor=Green
IaColor=Red
IbColor=Blue
IcColor=Green
InColor=Fuchsia
PosSeqR=0.46301
PosSeqX=2.50905
ZeroSeqR=5.09427
ZeroSeqX=5.66559
LineMiles=9.9
FromBus=1400
ToBus=1000
Cktnum=50
PhaseRotation=ABC

TimeAdjustment=-4

For relay files a line group file will contain one line group, but for DFR files a maximum of 25-line groups can exist in one file. Below are definitions for each line in a line group:

Field	Description	Format
LINE NAME	Feeder Name	Text (up to 12 Characters)
REMOTE DME	Remote DME Station Name	Text (up to 24 Characters)
REMOTE NAME	Remote Line Designation	Text (up to 12 Characters)
REMOTE DEVICE	Remote Device Name	Text (up to 24 Characters)
VA CHAN	VA Analog Channel Number	Integer Number (1 to 255)
VB CHAN	VB Analog Channel Number	Integer Number (1 to 255)
VC CHAN	VC Analog Channel Number	Integer Number (1 to 255)
IA CHAN	IA Analog Channel Number	Integer Number (1 to 255)

IB CHAN	IB Analog Channel Number	Integer Number (1 to 255)
IC CHAN	IC Analog Channel Number	Integer Number (1 to 255)
IN CHAN	Neutral Analog Channel Number	Integer Number (1 to 255)
BREAKER 1	Digital Channel – Breaker 1 Status	Integer Number (1 to 1024)
BREAKER 2	Digital Channel – Breaker 2 Status	Integer Number (1 to 1024)
EVENT 1	Digital Channel – Event 1 Status	Integer Number (1 to 1024)
EVENT 2	Digital Channel – Event 2 Status	Integer Number (1 to 1024)
EVENT N	Digital Channel – Event N Status	Integer Number (1 to 1024)
VA COLOR	VA Channel Color	Text (Example: Red)
VB COLOR	VB Channel Color	Text (Example: Blue)
VC COLOR	VC Channel Color	Text (Example: Green)
IA COLOR	IA Channel Color	Text (Example: Red)
IB COLOR	IB Channel Color	Text (Example: Blue)
IC COLOR	IC Channel Color	Text (Example: Green)
IN COLOR	Neutral Channel Color	Text (Example: Fuchsia)
POS SEQ R	Real Positive Seq Line Impedance	Real Num (5 Decimal Digits)
POS SEQ X	Imaginary Positive Seq Line Impedance	Real Num (5 Decimal Digits)
ZERO SEQ R	Real Zero Seq Line Impedance	Real Num (5 Decimal Digits)
ZERO SEQ X	Imaginary Zero Seq Line Impedance	Real Num (5 Decimal Digits)
LINE MILES	Total Line Length in Miles	Real Num (2 Decimal Digits)
FROM BUS	CAPE From Bus Designation	Integer Number (up to 9999)
TO BUS	CAPE To Bus Designation	Integer Number (up to 9999)
CKT NUM	CAPE Circuit Number	Integer Number (up to 9999)
PHASEROTATION	The Phase Rotation (ABC - ACB)	Text (up to 3 Characters)
TIMEADJUSTMENT	The number of hours to adjust to the proper time.	Integer

TEMPLATES

Once the line groups are defined then template files can be built to extract key information from the files. Below is a list of the script commands that can be used in the template files.

Window Commands

<Station>	Write the full Station name.
<Station:12>	Write the first 12 characters of the Station name. If the Station name is less than 12 characters then blanks are pads in front of the name.
<Device>	Write the full Device name.
<Device:6>	Write the first 6 characters of the Device name.
<Date:F>	Write the Date at the data bar in the following format mm/dd/yyyy.
<Time:F>	Write the Time at the data bar in the following format hh:mm:ss.zzzzzz.
<Date:U>	Write the Date at the data bar in the following format yyyymmdd.

<Time:U>	Write the Time at the data bar in the following format hhmmsszzz.
<Cycles>	Write the number of Cycles between the data bar and the reference bar.
<DeltaX>	Write the time difference between the data bar and the reference bar.
<Line>	Write the active Line name.
<Data>	Write if the data being processed is BAD or GOOD. This is determined by the size of the binary file compared with the calculated size using the total samples * scan size.
<Remote>	Write the Remote Feeder Name as defined in the Line Group, REMOTENAME=.
<RDME>	Write the Remote Station Name as defined in the Line Group, REMOTEDME=.
<RDEV>	Write the Remote Device Name as defined in the Line Group, REMOTEDEVICE=.
<PHSROT>	Write the Phase Rotation as defined in the Line Group, PHASEROTATION=.
<SFreq>	Write the sampling frequency at the data bar or reference bar.
<LFreq>	Write the line frequency.
<LL>	Write the Line Length.
<Z1M>	Write the Z1 Magnitude.
<Z1P>	Write the Z1 Angle.
<Z0M>	Write the Z0 Magnitude.
<Z0P>	Write the Z0 Angle.
<Filename>	Write the Filename displayed in the data plotting window.
<Triggers>	Write the number of triggers for the script commands.
<Cktnum>	Write the Circuit Name as defined in the Line Group as CKTNUM=.
<Tobus>	Write the To Bus Name as defined in the Line Group as TOBUS=.
<Frombus>	Write the From Bus Name as defined in the Line Group as FROMBUS=.
<ReportFile>	Write the name of the generated PDF report file. If there was no report file generated it writes NONE.

Analog Commands

<>	Write the analog data at the data bar,
[]	Write the analog data at the reference bar,
Number	Write the visible analog column data at the date bar separated by commas for specified Channel number.
^Number	Write all the visible analog column data separated by commas for the Channel in number position.
:A	Write the average value for the whole channel.
:C	Write the RMS value for the last cycles in the file.
:R	Write the RMS value.
:T	Write the Channel Title.
:U	Write the Channel Unit.
:P	Write the Phase value.
:I	Write the Instantaneous value.
:F	Write the DFT magnitude for the specified Harmonic. For example, ^6:F0 writes the DFT Magnitude of the DC Offset for channel 6 and ^6:F2 writes the DFT Magnitude of the 2nd Harmonic for channel 6.
:D	Write the Duration of the Fault.
:H	Write the value DC Offset divided by the fundamental. Indicates a pegged channel.
:X	Write the CT ratio.
:Y	Write the PT ratio.
:Z	Write the frequency.
:W	Write the megawatts.
:V	Write the megavars.
:%	Write the Percentage of Nominal from the Prefault bar to the Fault bar.
:%v	Measures voltage sag immunity.
:+	Write the channels maximum value.
:-	Write the channels minimum value.

:Number	Specifies the width of the analog data values. Will only be applied if the defined width is greater than the length of the data values. Spaces are padded to the beginning of the written values. This is used to right justify values.
:S	The skew of the 3 analog channels using the angles. The S command is used with 3 analog channels <1,2,3:S>. This command adds the 3 angles at the cursor. One of the channels must be marked as a reference channel.
:B	The Unbalanced Value for 3 Channels. The B command is used with 3 analog channels <1,2,3:B>. This command finds the highest and lowest DFT magnitude of the 3 channels. The result is the highest – lowest.
:N	The Negative Sequence for 3 Channels. The N command is used with 3 analog channels <^1,^2,^3:N>. This command computes the negative sequence for the 3 current or voltage channels in position 1, 2 and 3 on the screen. The magnitude for the negative sequence result is displayed.
:Q	The Positive Sequence for 3 Channels. The Q command is used with 3 analog channels <^1,^2,^3:Q>. This command computes the positive sequence for the 3 current or voltage channels in position 1, 2 and 3 on the screen. The magnitude for the positive sequence result is displayed.
:M	The M command is used for an entire channel. It calculates the maximum value of the channel minus the minimum value of the channel divided by 2 ((max-min)/2), <^1:M>. Since the command is not sample based both types of brackets can be used (<>,[]).
:SG100 :BL50 :NG5000 :ML700	The letter G or L followed by a number after the :S, :B, :M or :N defines a trigger. The letter G stands for greater than and L is less than. If the result is true than Alarm is displayed else Normal is displayed.

Example Analog Commands

<1>	Write the visible analog column data at the date bar separated by commas for Channel 1.
<^1>	Write the visible analog column data separated by commas for the Channel in position 1.
<1:R>	Write the RMS value at the data bar for Channel 1.
<2:T>	Write the Channel Title for Channel 2.
<^3:U>	Write the Channel Unit for the Channel in position 3.
<4:P>	Write the Phase value for channel 4.
<^5:I>	Write the Instantaneous value for the Channel in position 5.
<6:F5>	Write the DFT magnitude of the 5th Harmonic for Channel 6.
[^1]	Write the visible analog column data at the reference bar separated by commas for Channel 1.
<^1:MG1000>	Write Alarm if the ((max-min) / 2) is greater than 1000 else it writes Normal.
<^1,^2,^3:S>	Write the sum of the angles at the data bar. One of the 3 channels must be marked as a reference channel.
[^1,^2,^3:B]	Write the difference between the highest and lowest DFT magnitude at the reference bar.
<^1,^2,^3:N>	Write the magnitude of the negative sequence at the data bar for the channels in position 1, 2 and 3.
<^1,^2,^3:NG50>	Write Alarm if the magnitude of the negative sequence is greater than 50 or it write Normal if the magnitude of the negative sequence is less than or equal to 50 for the channels in position 1, 2 and 3 at the data bar.

Digital Commands

B1:T	Write the Breaker 1 Digital Channel Trigger Information as defined in the Line Group as Breaker1=. The output text is the Digital Channel Title/Start Second:Milliseconds/Duration. If the Digital Channel started in Alarm state, then NA is defined as the start date. If the Digital Channel started in Alarm state or ended in

	Alarm state, then NA is written for the Duration.
B2:T	Write the Breaker 2 Digital Channel Trigger Information as defined in the Line Group as Breaker2=. The output text is the Digital Channel Title/Start Second:Milliseconds/Duration. If the Digital Channel started in Alarm state, then NA is defined as the start date. If the Digital Channel started in Alarm state or ended in Alarm state, then NA is written for the Duration.
E1:T	Write the Event 1 Digital Channel Trigger Information as defined in the Line Group as Event1=. The output text is the Digital Channel Title/Start Second:Milliseconds/Duration. If the Digital Channel started in Alarm state, then NA is defined as the start date. If the Digital Channel started in Alarm state or ended in Alarm state, then NA is written for the Duration.
B1:S	Write A (Alarm) or N (No Alarm) indicating if the Breaker 1 Trigger status in the File.
E3:D	Write the Event 3 Start Time
B1:E	Write the total number of times the digital channel toggled.

When a carat ^ is specified before the channel number it indicates the channel position in the display.

The < > characters saves the analog data at the data bar and the [ ] characters saves the analog data at the reference bar. To open the Auto Process Template dialog, select the Process Templates icon under the Options tab.

The Auto Process Template dialog allows for 5 templates to be processed at one time. Enter or select the template files in the template fields. Enter or select the report path where the report files are saved. If the Process Type defined in the File Manager's display dialog is Rename with WWD then the Process Files field will be enabled. Select what files to process, All Files will process all the files in the active path and included sub folders. After a file is processed a WWD is added to the last field in the long filename. This tags the file as processed. To only process new files, select the New Files option.

If the Process Type defined in the File Manager's display dialog is By Save Date, then all files that have a save date greater than the one defined in the Display dialog are processed.

If files are marked in the active path the Process Only Marked Files check box will be enabled. Click this option to process only the marked files. To include all the sub folders under the active path, click the Include Sub Folder check box.

To start the process, click the Run button. When the Run button is activated the fields in the dialog will be saved and the dialog will be closed. Each specified file will be opened in the analysis window, the Mark and Save window will be opened and each line group will be selected in the file. The template fields will be processed for each line group and saved to the appropriate report file. The report files are saved to the specified report path and each report file will have the same name as the template file with a .DIG extension.

To view the report files, navigate to the report path and double click on the .DIG files. The report will be displayed in a table format. To plot the file with the specified line group double, click on the desired row.

AUTOMATICALLY RENAME FILES

The Automatically Rename Files feature monitors a folder for waveform/load files with user defined extensions. The files are renamed to the IEEE Long file naming format C37.232 ComNames Standard.

When a file is detected in the source path or in its included folders it will first move the original file to the Archive path then read the file's configuration information and rename the file to the destination path.

To activate this feature, select the Auto Rename Files option under the Options menu/tab. A dialog will be displayed.

Enter the Source Path, click the Include Sub Folders check box if needed. Enter the Destination, Archive and Erro Paths. Any files that encounter a problem reading will be copies to the Error path. Enter all file extensions (*.DAT,*.CEV,*.CFF) and the scan period. If this feature needs to start when Wavewin runs, click the Automatically Start Auto Rename Files at Run Time checkbox. The bottom section of the dialog gives a status update on the activity of the process. It displays the last scan time, the original and Renamed filenames and when the next scan will start in minutes. To start the process, click the Start Rename button. Once the conversion starts the button caption will change to End Rename. To end the process, click on the End Rename button.

To have the auto rename process started when Wavewin is run check the Automatically Start Auto Rename Files at Run Time check box. The conversion process is performed in the background. So, the dialog is not required to be open for the process to execute. To check the status of the renaming, open the dialog. The Next Scan In field reports how many minutes before the next scan is started.

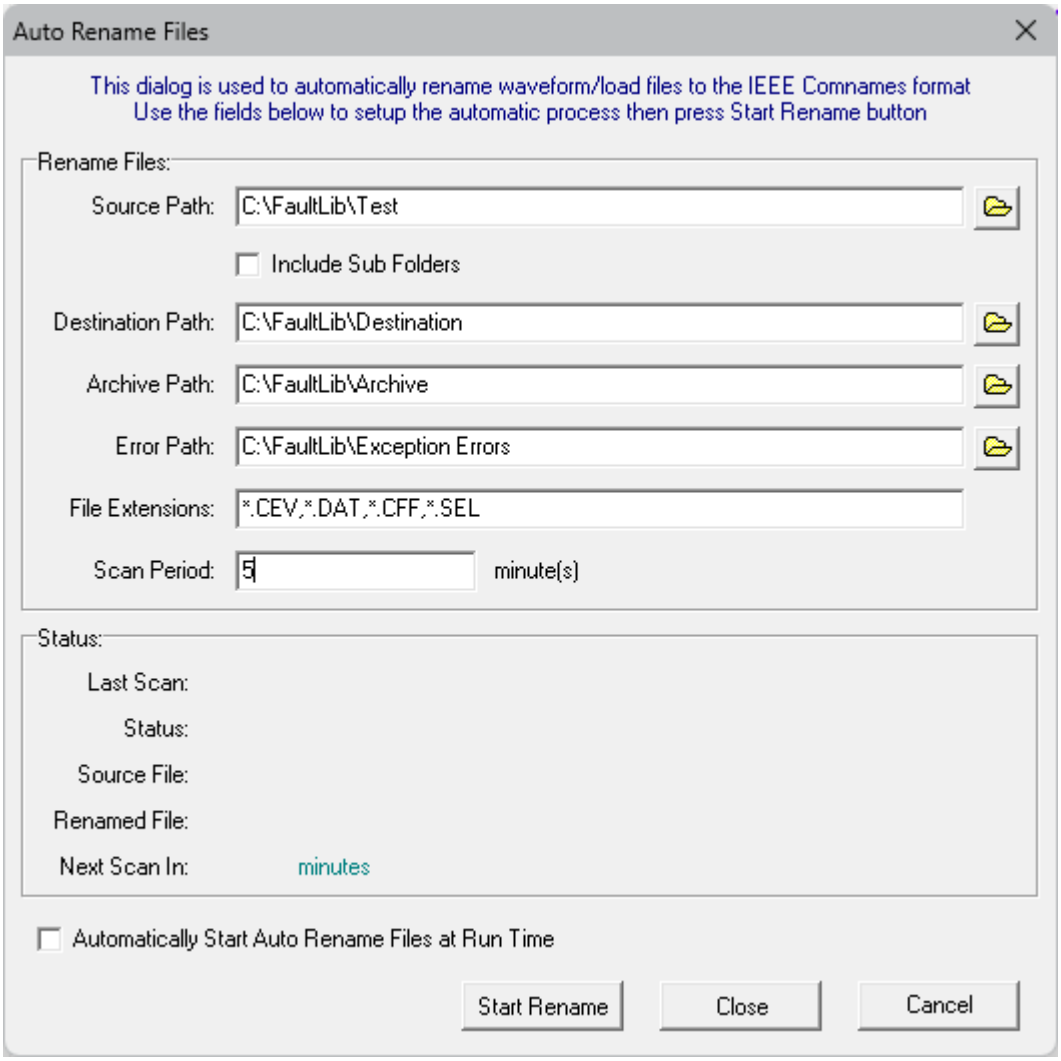


Figure 2.47 Automatically Rename Files Dialog

CREATE SER REPORTS

The Create SER Reports feature monitors a folder for waveform files with user defined extensions. When a file is detected, it will read the file and create a comma delimited SER file from the digital channel activity. The SER file will have the same name as the original waveform file with a .SER extension.

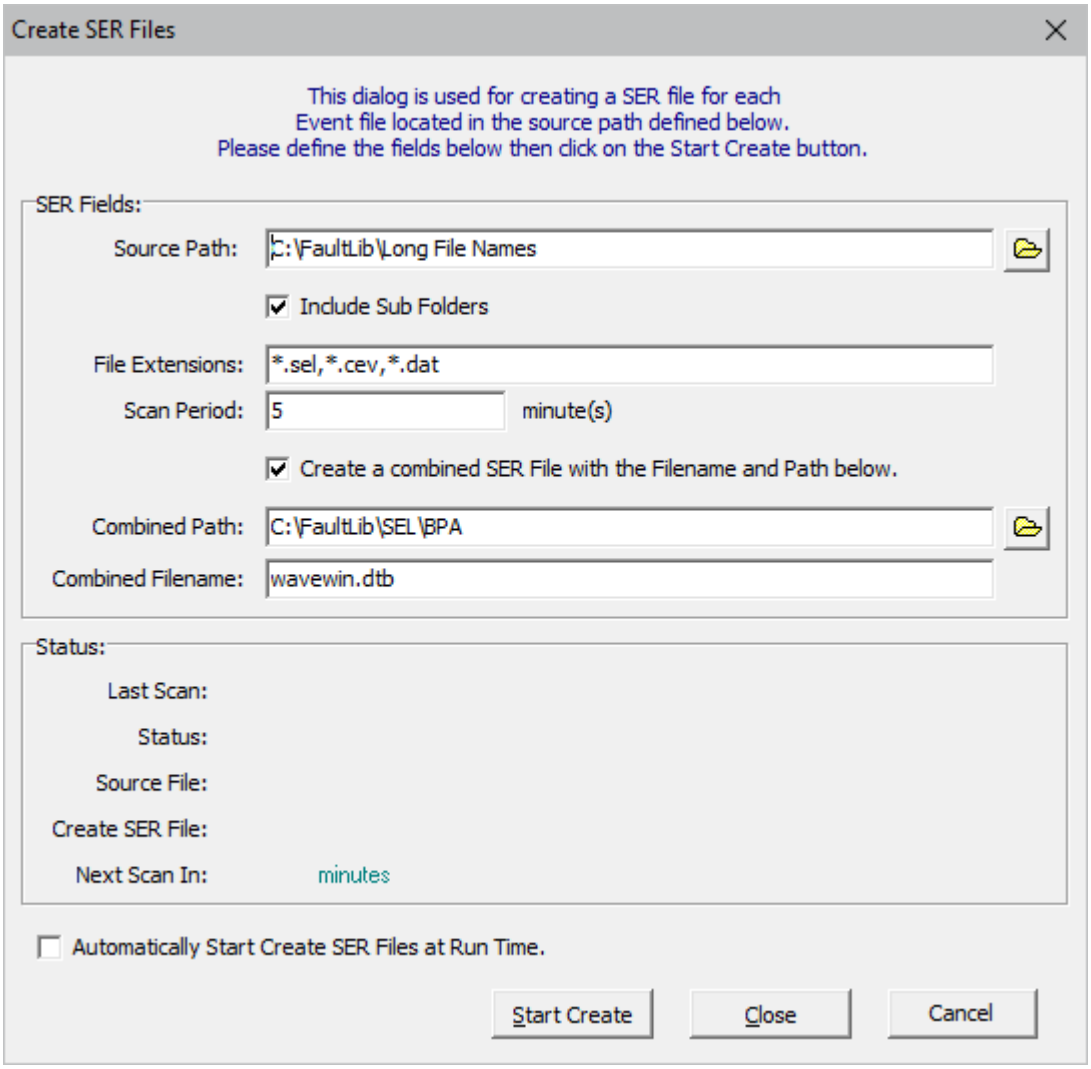


Figure 2.48 Automatically Create SER Files Dialog

To activate this feature, select the Create SER Files option under the Options menu/tab. A dialog will be displayed. Enter the Source Path, click the Include Sub Folders check box if needed, enter the file extensions, such as (*.DAT,*.CEV,*.CFF), Enter the scan period. If this feature needs to start when Wavewin runs, click the Automatically Start Create SER File at Run Time checkbox. The bottom section of the dialog gives a status update on the activity of the process. It displays the last scan time; the original and SER filename being processed and when the next scan will start in minutes. To start the process, click the Start Create button.

To create an SER file with all the digital activity from all processed Waveform files click on the Create a Combined SER File check box. Select or enter the path of the Combined file and enter its filename along with its extension. This allows for adding the SER information into a database from one single file.

To create the SER files for each file being processed by the Auto Process Templates add /SER to each line in the Format files being processed.

APPEND CSV FILES

The Append CSV files will append all the marked CSV files in the active folder that have the same number columns. The number of columns is determined by the first file marked in the File Manager.

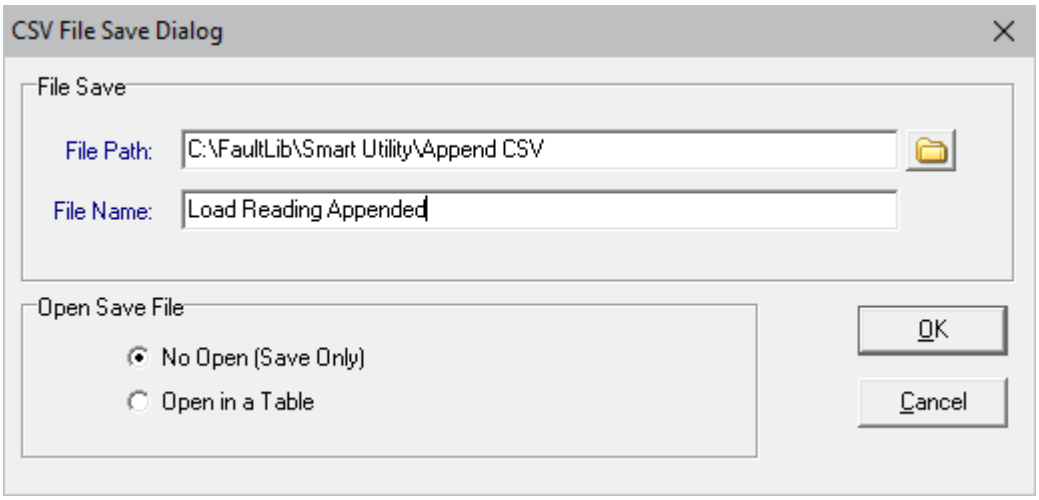


Figure 2.49 Append CSV Files Dialog

To Append CSV files first marked all the files using the spacebar or mouse. Next, select the Append CSV files… menu option under the Options/Reports submenu. In the dialog select or enter the path for the combined file. Enter the filename and select to only save the file or to save and view the file in a table. Then click ok. To cancel the append click cancel.

After all the files have been appended the final appended file can be displayed in the data plotting window. To plot the file double, click on the final CSV file. If it cannot be plotted, then it will be displayed in Excel.

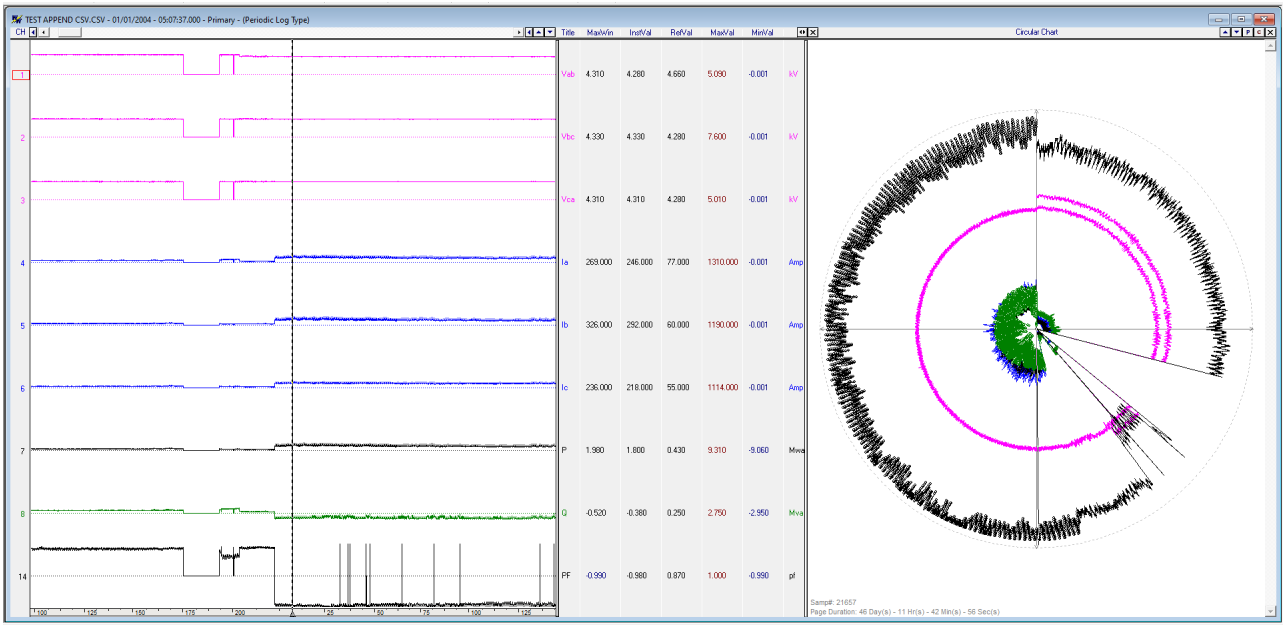


Figure 2.50 Append CSV Plotted

EXPORT FILE TABLE

Export the contents of the File Manager's table to a comma delimited CSV file. Select the path to save the file in and enter the filename. To export all the files in the table, click the All-Files radio button. To export only the marked files in the table click the Marked Files radio button.

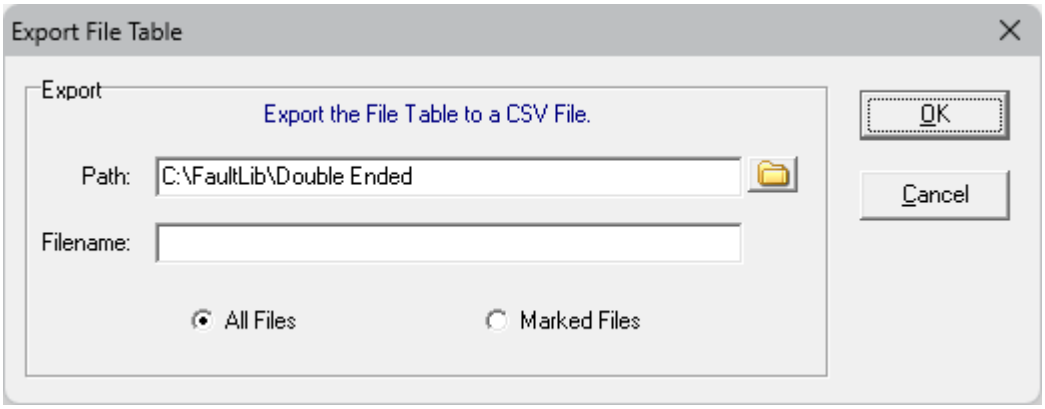


Figure 2.51 Export File Table

C H A P T E R 3

Analysis Quick Start

This chapter describes the main features of the Analysis Display.

Analysis Features

The Analysis Display offers a high-resolution graphical interface for displaying, analyzing, and manipulating analog and digital channels of an oscillography record or a periodic load file. Displayed channels can be marked, merged, appended, moved, zoomed, removed, restored, superimposed, scaled, numerically processed, exported, and summarized. A maximum of ten data windows can be opened at one time.

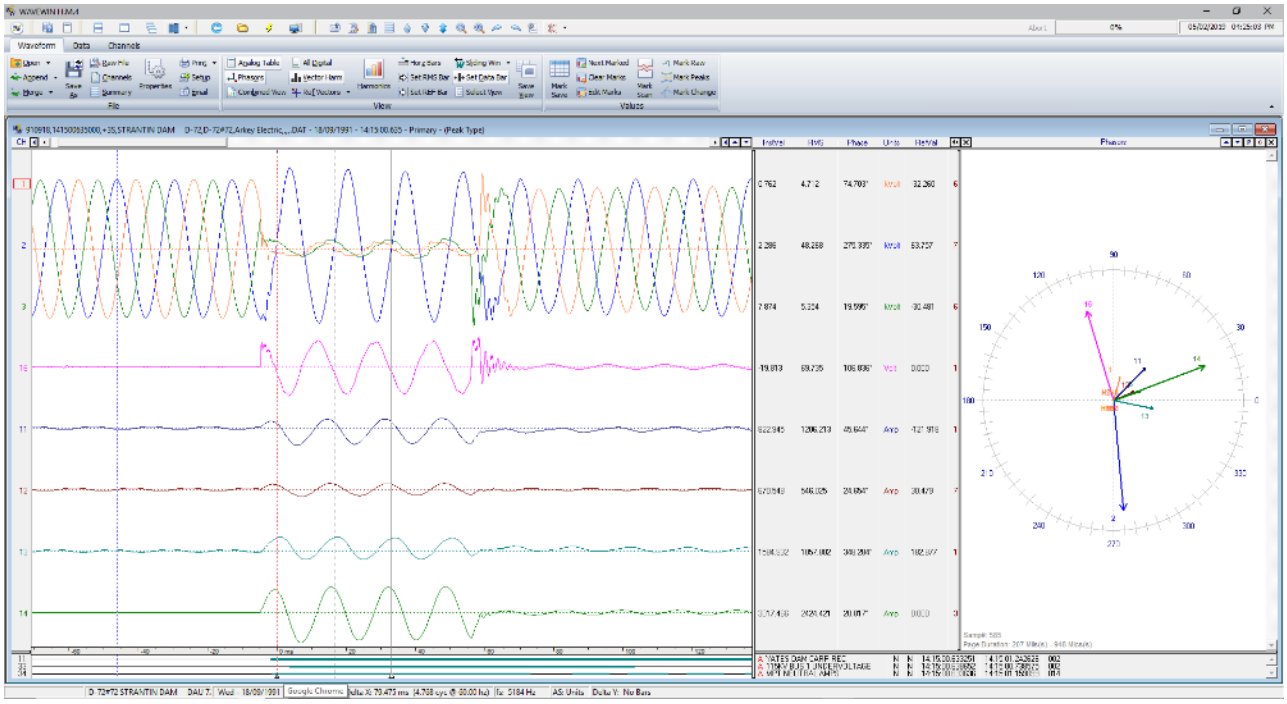


Figure 3.1 Analysis Display

The Analysis Display contains two sections: the analog view and the digital view. The analog view plots the oscillography or load data. The analog table displays values such as the channel's highest peak, RMS, phase, reference, instantaneous, maximum, and minimum values. The cursor bars are used to view the data values. The digital view plots the events and sensors and displays the channel's original state, the channel's final state, time of the first change, time of the last change, and the number of times the channel changed state.

Up to 256 analog and 5000 digital channels can be displayed in the window. A maximum of 10 data windows can be opened at the one time. The main features are described below.

PHASORS

The phasor diagram shows a vector for each visible analog channel. It also shows a vector at the reference bar for the first channel or the first marked channel if the option is selected. To show the vector

at the reference bar select one of the 3 options (Off, All, Marked) under the Ref Vectors drop down options under the Waveform tab.

The vector diagram is displayed to the right of the analog information window. To increase or decrease the size of the phasor window place the cursor over the vertical separator between the analog information window and the phasor window and drag the mouse to the left to increase or to the right to decrease. To close the phasor window, click the close button located in the header. To reopen the phasor window, select the Phasor icon under the Waveform tab or position the mouse over the analog channel's scrollbar displayed to the right of the analog channel table and move the mouse until the cursor becomes a double arrow. When the cursor changes to a double arrow drag the window to the left to reopen the window.

To navigate the phase angles, use the left arrow, right arrow, home, end, page up and page down keys or the data scroll bar. To increase/decrease the length of a channel's vector, mark the channel and use the increase/decrease amplitude menu buttons or the Ctrl-Up and Ctrl-Down keys. To increase/decrease only the length of the vectors, use the up and down phasor buttons. 

To toggle between the phasor display and the circular chart display click the "P" button above the phasor display for phasors or the "C" button for a circular chart. 

There are two types of phasor displays: non-referenced and referenced. The non-referenced display shows the phase angle for each sample in the display. The reference display shows the phase angle for each sample with respect to the reference channel. The reference channel is the first marked channel in the window. All angles at a sample are subtracted from the reference angle. If there are no marked channels the non-referenced display is shown.

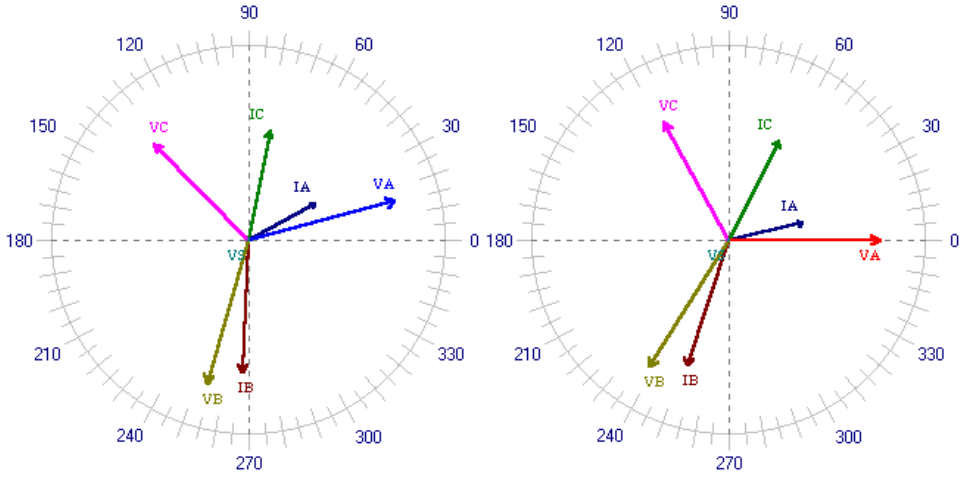


Figure 3.2 (a) Non-Referenced Phasors (b) Referenced Phasors

HARMONICS

The harmonics window displays as many harmonics as possible based on the file's sampling frequency. A maximum of 200 harmonics can be displayed in the table. To display the harmonics window right click in the phasor diagram or in the analog information table and select the Harmonics menu option. The harmonics window displays the first marked analog channel or if no channels are marked, the first visible channel. Changing the marked channel in the data plotting window will update the harmonics window with the appropriate channel.

The harmonic calculation is performed on a one cycle window, starting at the RMS bar, and going forward to the data bar. There are three fields displayed at the bottom of the harmonics table and histogram, TrueRMS, CalculatedRMS and Total Harmonic Distortion (THD). The TrueRMS field displays the RMS value calculated by using the samples in the active cycle displayed in the waveform trace window. The

CalculatedRMS field displays the square root of the summation of the squares of the DFT Magnitudes from harmonics 2 to the maximum harmonic divided by square root of 2. The maximum harmonic is the number of samples per cycle divided by 2. The THD field displays the square root of the summation of the squares of the DFT Magnitudes from harmonics 2 to the maximum harmonic and that quantity divided by the DFT Magnitude of the Fundamental.

The harmonics can be viewed in a table format or in a histogram. Click on the harmonics toggle button  to change the view. The histogram can show only one column from the table. To change the data displayed click the histogram drop down menu and select the column. The default view is the % of Fundamental.

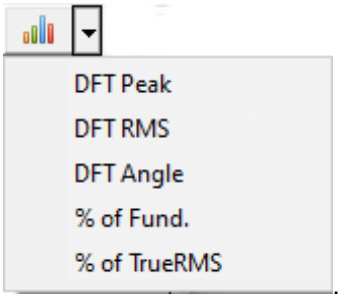


Figure 3.3 Histogram Drop Down Menu

The harmonic histogram bars can be resized using the resize up and down arrows  to display more or less harmonics in the window. The text displayed above the histogram bars can be shown or hidden be clicking on the Show/Hide text bar button  . The harmonics window can be resized by dragging the edge of the window to show more or less harmonics per window.

Also, a vector for each harmonic is displayed in the phasor diagram, up to the 11th harmonic. To hide/show the harmonic vectors toggle the Vector Harmonics menu option under the View menu from checked=on to unchecked=off.

The 0th harmonic represents the percentage of DC offset in the channel.

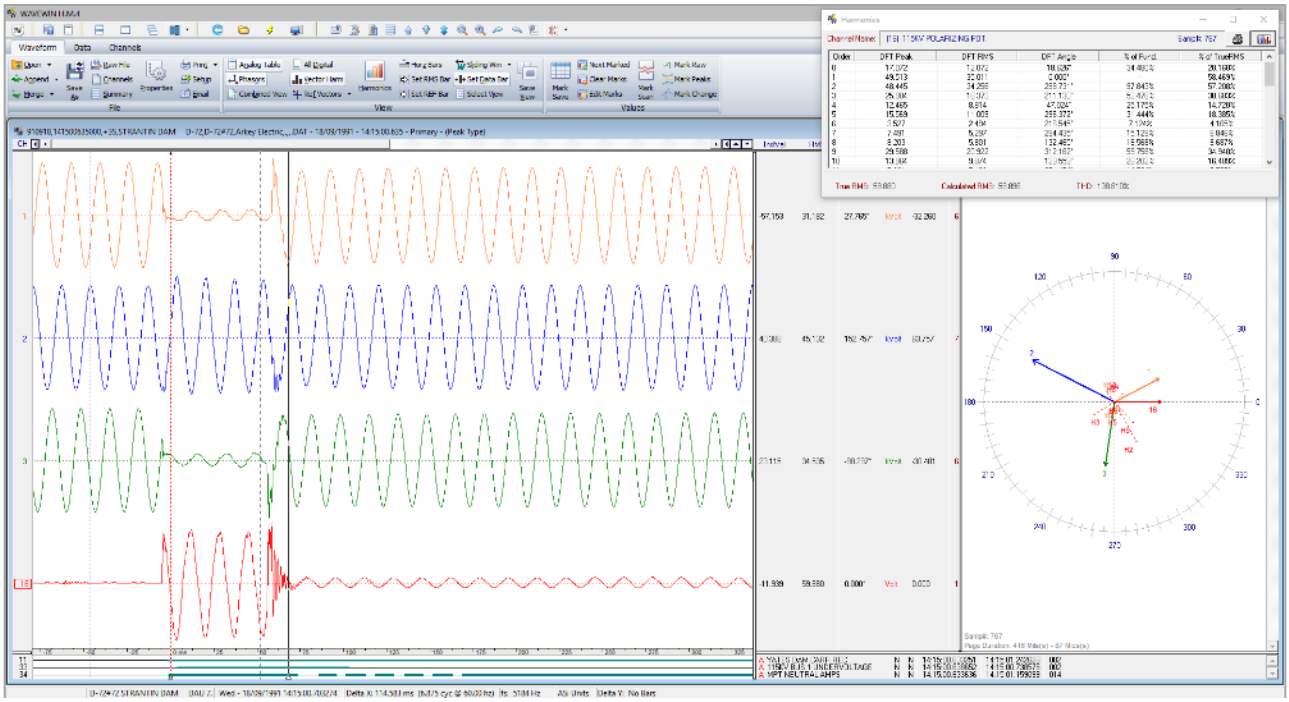


Figure 3.4 Harmonics Table View

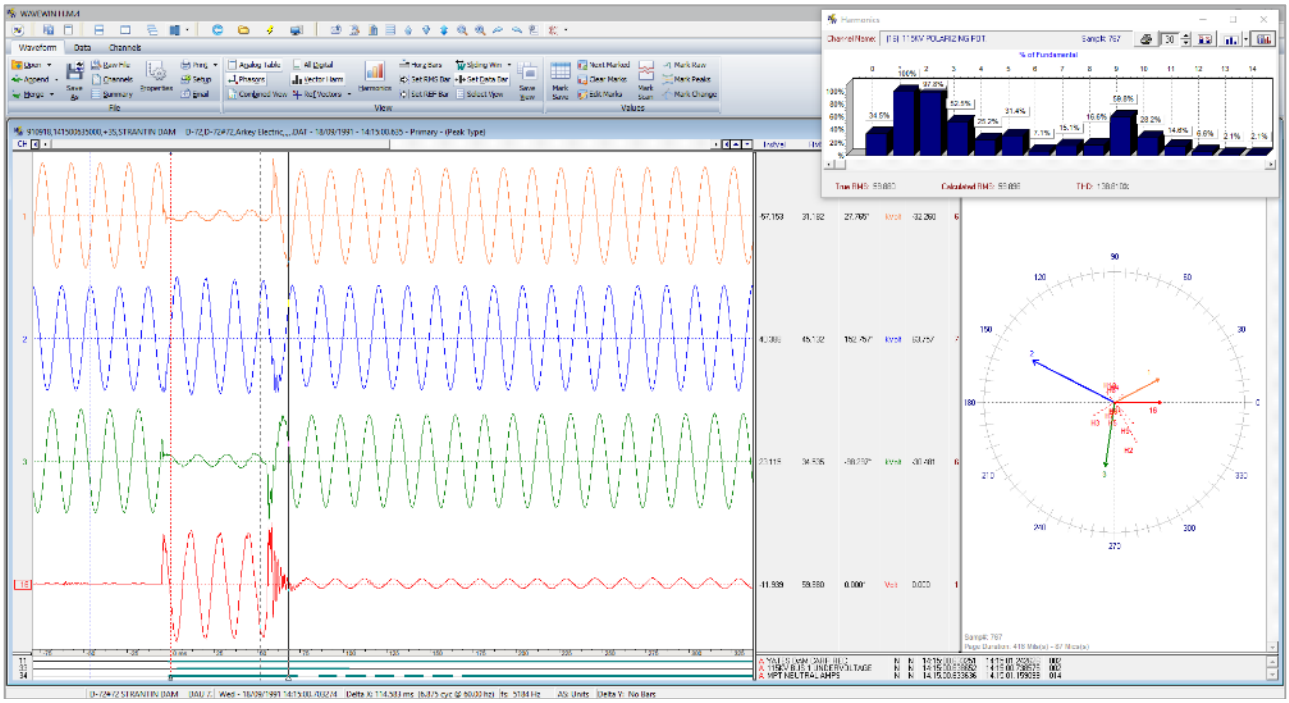


Figure 3.5 Harmonics Histogram View

PERIODIC LOG FILES

The periodic log viewer allows for viewing and analyzing large amounts of event data in a single display. The data is displayed in envelope form and may contain one day, one week, one month or one year of event data. This feature is useful for load flow analysis.

A circular chart of the data displayed in the trace window is plotted to the right of the channel information window. The circular chart cursor is positioned on the sample at the waveform data bar. The duration of the data displayed also is shown below the circular chart along with the sample number at the cursor bar.

The ABB Load Profile and SDC log drivers are specific drivers used to view periodic log data. The COMTRADE format also displays log data. The ABB Load Profile format is an ASCII text file that contains time sequenced load information. The SDC Log format is an ASCII comma delimited CSV text file. The first line of the file is the header information. These files are generated from the Fault Data Concentrator (FDC).

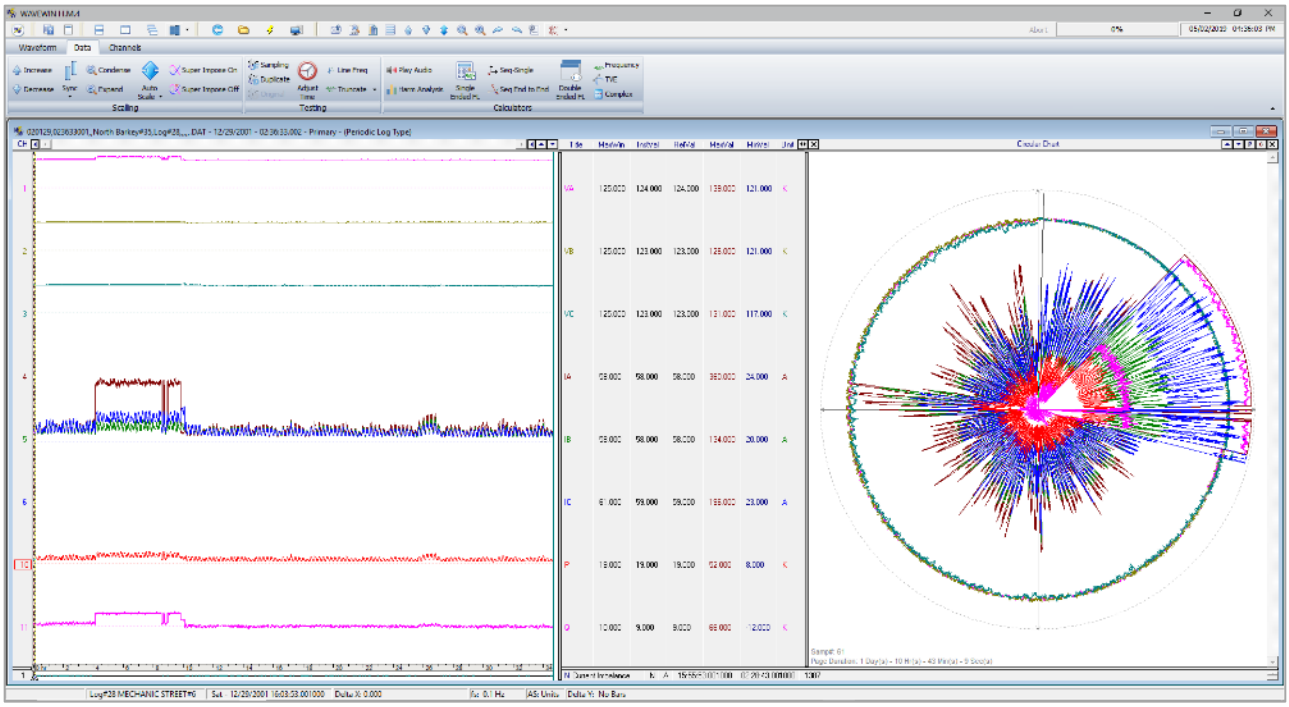


Figure 3.6 Periodic Log File

CIRCULAR CHART

The Circular Chart diagram shows a circular display for each visible channel. The diagram is displayed to the right of the analog information window. The amount of data displayed in the circular chart is equal to the amount of data displayed in the waveform trace window. The duration of the data displayed is shown at the bottom of the circular chart. To increase or decrease the size of the circular chart window place the cursor over the vertical separator between the analog information window and the circular chart window and drag the mouse to the left to increase or to the right to decrease. To close the circular chart window, click the close button ☒ located in the header.

To navigate the circular chart, use the left arrow, right arrow, home, end, page up and page down keys or the data scroll bar. The cursor bar on the circular chart displays where the data bar is in the plot. To increase/decrease the display area of a channel on the circular chart, mark the channel and use the increase/decrease amplitude menu buttons or the Ctrl-Up and Ctrl-Down keys or use the up and down arrow button ▲▼ located in the circular chart header.

Negative values in the circular chart are displayed with a small circle at each negative value.

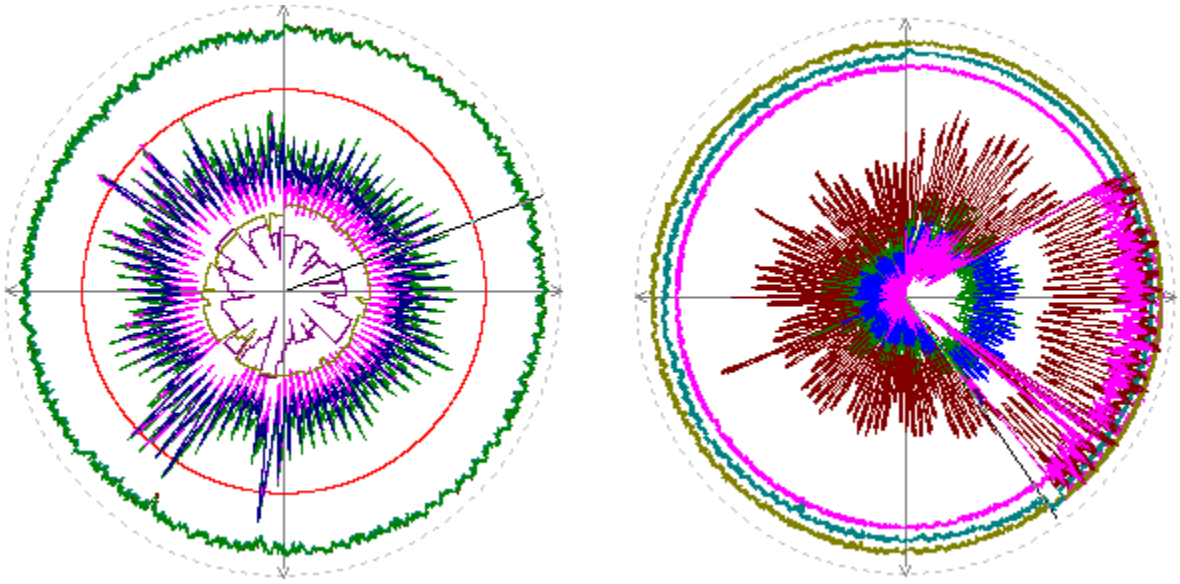


Figure 3.7 Circular Charts

DISPLAY DRIVER'S DATA TYPE

The data stored in the displayed file can be instantaneous values or RMS values. The default setting for all drivers is instantaneous values. If the display driver saves the sample values as RMS calibrated, set the display driver's data type to RMS Type (Root 2 Multiplier). If the display driver is not set properly the analog column data will be displayed incorrectly. To set the driver's data type click the Window Properties  menu button from the speed bar or select the Properties icon under the Waveform tab. Click the Driver Data Type tab and set the Display Device's Data Type field to RMS Type for RMS calibrated values and Peak Type for instantaneous values.

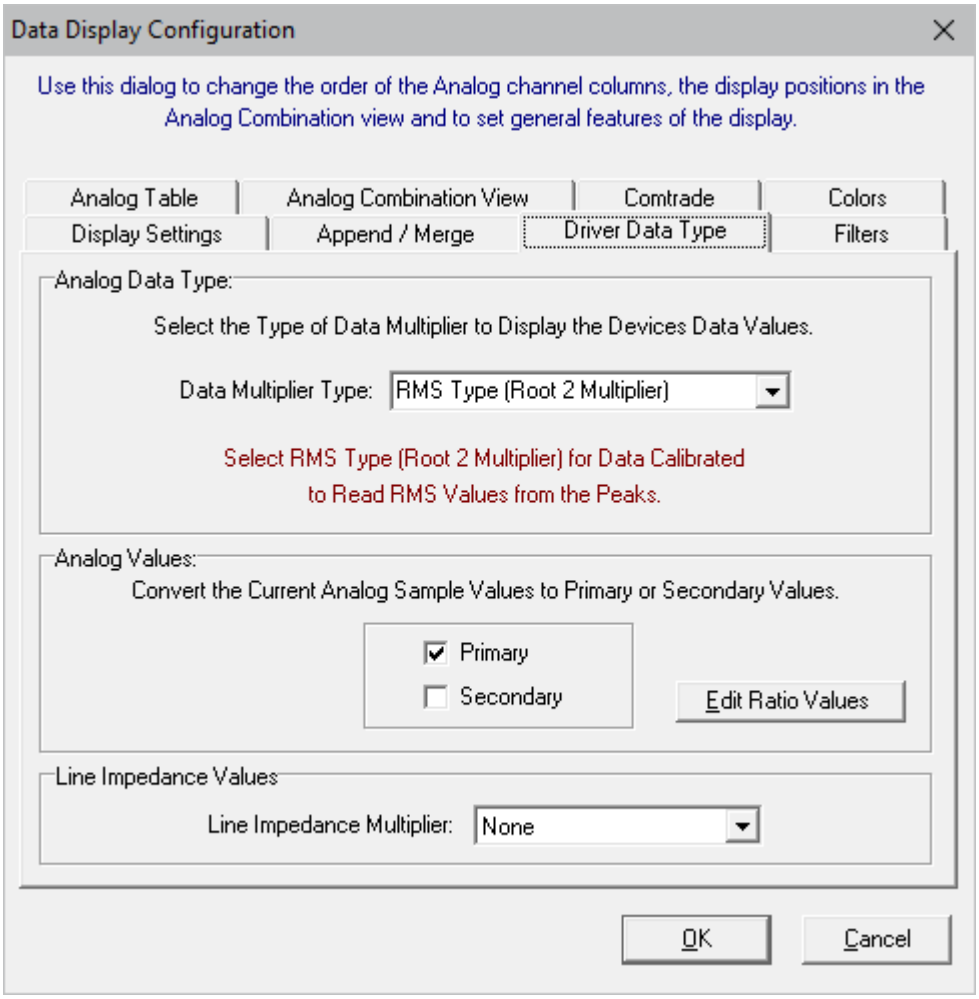


Figure 3.8 Analog Data Type Setting

REOPEN WAVEFORM FILE

To reopen a waveform file that was previously viewed click on the Open icon drop down list under the Waveform tab.

Figure 3.9 ReOpen Data File

EMAIL ACTIVE FILE

The active data file can be emailed by clicking on the email menu button or by selecting Email icon under the Waveform tab. The data file in the active analysis window and all the support files associated with the file are included as attachments. The users default email program will be displayed to email the file(s).

NAVIGATING

Use the up and down arrow keys or the vertical scroll bar to browse the analog channels. The tab key toggles between the analog and digital views.

The analog and digital values are displayed in a table to the right of the channel traces. Hold the mouse button down and drag the table separator bars to resize the viewing area. To view the analog sample values, use the following navigation tools:

- Left and right arrow keys to navigate sample by sample.
- Ctrl+left or ctrl+right keys to peak navigate.
- Shift+ctrl+left or shift+ctrl+right keys to cycle hop.
- Home and end keys to display the channel's first and last samples.
- Triangle △ at the bottom of the data bar to drag the data bar through the samples.
- Page up and page down keys to page through the samples.
- Left button displayed to the left of the data scroll bar to move the sample at the data bar to the position of the first sample displayed.
- Left button displayed to the right of the data scroll bar to move the trace and table separator to the position of the data bar.

Click the left/right arrow button (located to the right of the analog table headers) or use the shift-right/left arrows to scroll through the analog table columns. Refer to the Viewing Analog Data section for field descriptions.

NOTE: If no channels are marked then the peak navigate, and cycle hop features navigate through the first displayed channel's data.

SETTING THE CURSOR BARS

Four vertical cursor bars are displayed in the analog view. The blue dotted line represents the reference bar, the black solid line represents the data bar, the black dotted line represents the RMS bar, and the red dotted line represents the fault position defined in the file's configuration information. There are also two horizontal bars displayed when the Horiz Bars icon under the Waveform tab is selected.

DATA BAR

The data bar is displayed as a black solid line with a white triangle below the line. The position of the data bar is defaulted at the end of the first cycle in the data window when it is first displayed. To set the data bar's position to 2 cycles after the trigger position select the Set Data Bar icon under the Waveform tab.

To move the data bar use the left and right arrow keys to move one sample, use the Ctrl-left and Ctrl-right keys to peak hop, use the Shift-Ctrl-left and Shift-Ctrl-right keys to cycle hop, use the page up and page down keys to move one page up or down or left click the mouse to move to any position in the data or drag the triangle to scroll through the data. When the mouse is held over the triangle a hint message displays the sample number at the data bar and the delta time from the first sample. The time of the sample at the data bar is displayed in the second status bar field. The channel values at the data bar are displayed to the right of the traces in the analog channel information table.

REFERENCE BAR

The reference bar is displayed as a blue dotted line. The reference bar is defaulted to the fault time specified in the file. To move the reference bar to the position of the data bar use the Set Ref Bar icon under the Waveform tab or press Ctrl-A. Click the opposite mouse button to move the reference bar to any position in the data area. The status field Delta X in the status bar at the bottom of the screen shows the time difference (in milliseconds or seconds) between the reference bar and the data bar. It also shows how many cycles are between the two bars.

RMS BAR

The RMS bar is displayed as a black dotted line. The RMS bar is defaulted to one cycle away from the data bar, except when the data bar is positioned at the beginning of the data. This bar is used for calculating the RMS value displayed in the analog information table. The RMS value in the analog table is calculated using all of the sample values displayed between the data bar and the RMS bar. To move the RMS bar to the position of the reference bar (blue dotted line) use the Set RMS Bar icon under the Waveform tab or press Ctrl-Z.

FAULT BAR

The fault bar is displayed as a red dotted line. The fault bar is fixed and positioned at the fault time defined in the file's configuration information. The fault bar can be shown or hidden by selecting the "Yes" or "No" options for the Show Vertical Fault Bar field in the Properties dialog under the "Display Settings" tab.

HORIZONTAL BARS

When the Horiz Bars icon is highlighted under the Waveform tab two horizontal bars will be displayed. The solid black line follows the data bar, and the dotted blue line follows the reference bar. The bars will be positioned at the first marked analog channel (displayed in red), if no channels are marked, then

they are positioned at the first displayed channel. The Delta Y field in the status bar shows the difference between the two bars.

To automatically resize the RMS sliding window click on the Sliding Win drop down list or open the Sliding Window dialog by clicking directly on the button. To manually resize the RMS sliding window click the opposite mouse button to set the reference position and the mouse button to set the data bar position then click the SetRMS icon. The RMS bar is moved to the reference position. The Delta X field displayed in the status bar at the bottom of the screen shows the time difference (in milliseconds or seconds) between the date bar and reference bar and the number of cycles between the two bars. Use the left, right, ctrl+left, and ctrl+right, shift+ctrl+left, and shift+ctrl+right keys or the horizontal scroll bar to move the sliding window.

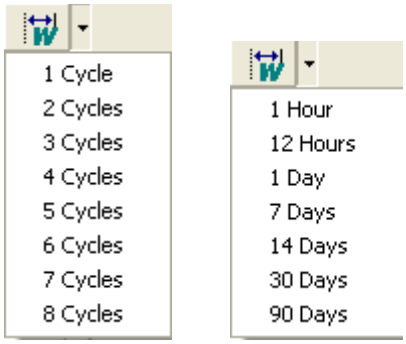


Figure 3.10 Resize Sliding Windows Drop Down Menus

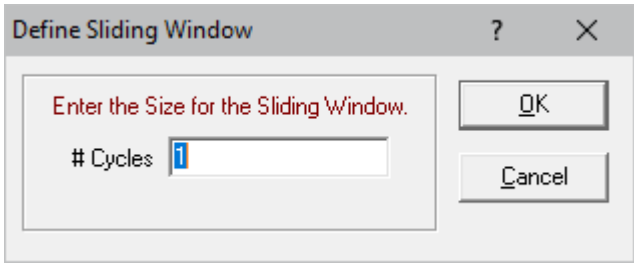


Figure 3.11 Resize Sliding Dialog for Waveforms

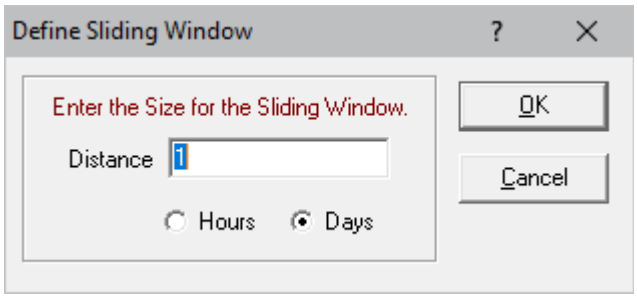


Figure 3.12 Resize Sliding Windows Dialog for Log Files

AUTO SET DATA BAR

The data bar (black solid line) is by default positioned one cycle from the first sample when the window is first displayed. To change the default to be 2 cycles from the trigger position defined in the file select the From File Trigger Position option under the Set Data Bar drop down menu option under the Waveform tab. The second option is to position the data bar from the system calculated trigger position.

MARK AND SAVE

The Mark and Save feature will save selected analog data to a user defined ASCII file using the selected template file. To open the Mark and Save window select the Mark Save icon under the Waveform tab. The window is divided into two sections. The top section displays the contents of the selected template file in a notepad editor and contains a drop-down list to select the template file. The list is initially populated with all the files that have a *.FMT extension located in the Wavewin directory. A browse button is available to add template files to the list that are not located in the Wavewin directory. To save a new template file, edit the contents of the existing template file, change the name of the file using the list box's edit box then click the Save button.

The bottom section displays the contents of the values file in a notepad editor and the location and name of the file. To save the analog data to a new file change the name of the file using the edit box or use the Browse button to create a new file, then click the Save button.

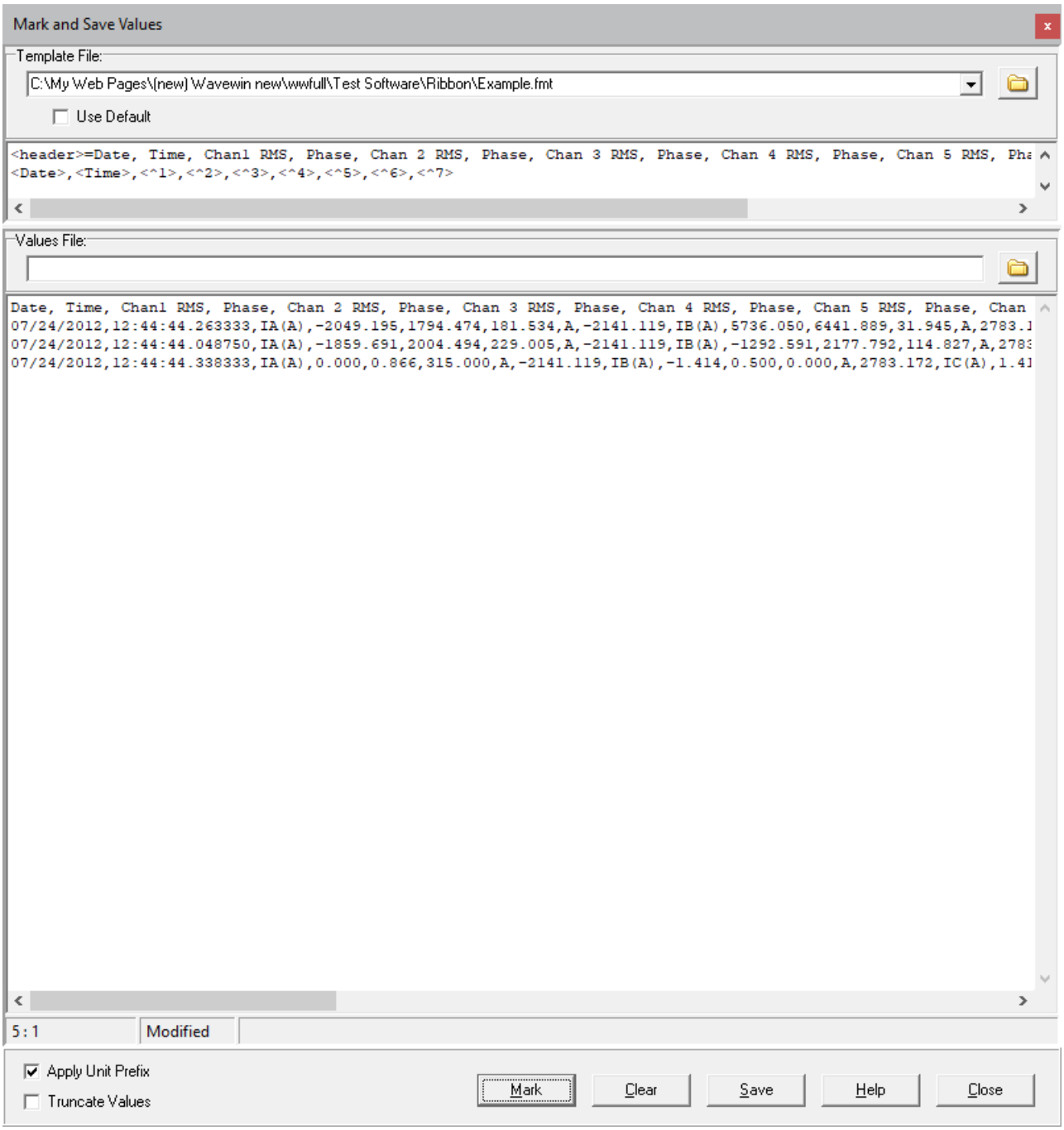


Figure 3.13 Mark and Save Window

The Apply Unit Prefix will multiply all analog values by 1000 if the values are in kilo. The truncate Values will save only integer values.

The Use Default checkbox will write the visible analog columns to the Values notepad with a header for each column.

Before savings values to an ASCII file the template files must be created. Refer to the next section on how to create a Template file.

TEMPLATE FILES

To create a new template file clear the contents of the existing template file in the notepad editor, change the name of the template file using the list box's edit box then click the Save button. To clear the contents of the Template notepad editor, mark the contents of the editor then press the delete key.

To save any changes made to the active template file click the Save button.

The template files use < > characters to define the available window commands and < > and [ ] characters define the analog commands. Review the Template Commands section for the supported Window and Analog commands.

To add a header to the Values file, define the first line in the template file with <Header>= followed by the header information. For example, the following two lines define the header and data of the Values file:

<Header>= Station, Device, Date, Time, RMS, Angle
<Station>, <Device>, <Date>, <Time>, <^1:R>, <^1:P>

Any text not in the < > and [ ] characters get written to the Values file as they appear in the template file.

Below is an example of a template file.

```
% Initial Postfault Quantities

save rect( <1> ) as P_Ia
save rect( <2> ) as P_Ib
save rect( <3> ) as P_Ic
save rect( <4> ) as P_In
save rect( <5> ) as P_kVa
save rect( <6> ) as P_kVb
save rect( <7> ) as P_kVc
```

Results of the values saved using the above template when only the RMS and Phase columns are visible in the data plotting analog table.

```
% Initial Postfault Quantities

save rect( 1096.346,172.477 ) as P_Ia
save rect( 577.000,24.181 ) as P_Ib
save rect( 3168.159,38.157 ) as P_Ic
save rect( 3024.967,50.501 ) as P_In
save rect( 219759.479,328.716 ) as P_kVa
save rect( 209623.595,209.628 ) as P_kVb
save rect( 174040.116,78.700 ) as P_kVc
```

TEMPLATE COMMANDS

Window Commands

<Station>	Write the full Station name.
<Station:12>	Write the first 12 characters of the Station name. If less than 12 it pads blanks.
<Device>	Write the full Device name.
<Device:6>	Write the first 6 characters of the Device name.
<Date:F>	Write the Date at the data bar in the following format mm/dd/yyyy.
<Time:F>	Write the Time at the data bar in the following format hh:mm:ss.zzzzzz.
<Date:U>	Write the Date at the data bar in the following format yyyymmdd.
<Time:U>	Write the Time at the data bar in the following format hhmmsszzz.

<Cycles>	Write the number of Cycles between the data bar and the reference bar.
<DeltaX>	Write the time difference between the data bar and the reference bar.
<Line>	Write the active Line name.
<Data>	Write if the data being processed is BAD or GOOD. This is determined by the size of the binary file compared with the calculated size using the total samples * scan size.
<Remote>	Write the Remote Feeder Name as defined in the Line Group, REMOTENAME=.
<RDME>	Write the Remote Station Name as defined in the Line Group, REMOTEDME=.
<PHSROT>	Write the Phase Rotation as defined in the Line Group, PHASEROTATION=.
<SFreq>	Write the sampling frequency at the data bar or reference bar.
<LFreq>	Write the line frequency.
<LL>	Write the Line Length.
<Z1M>	Write the Z1 Magnitude.
<Z1P>	Write the Z1 Angle.
<Z0M>	Write the Z0 Magnitude.
<Z0P>	Write the Z0 Angle.
<Filename>	Write the Filename displayed in the data plotting window.
<Triggers>	Write the number of triggers for the script commands.
<Cktnum>	Write the Circuit Name as defined in the Line Group as CKTNUM=.
<Tobus>	Write the To Bus Name as defined in the Line Group as TOBUS=.
<Frombus>	Write the From Bus Name as defined in the Line Group as FROMBUS=.
<ReportFile>	Write the name of the generated PDF report file. If there was no report file generated it writes NONE.

Analog Commands

< >	Write the analog data at the data bar,
[ ]	Write the analog data at the reference bar,
Number	Writes the visible analog column data at the date bar separated by commas for specified Channel number.
^Number	Writes the visible analog column data separated by commas for the Channel in position 1.
:A	Write the average value for the whole channel.
:C	Write the RMS value for the last cycles in the file.
:R	Write the RMS value.
:T	Write the Channel Title.
:U	Write the Channel Unit.
:P	Write the Phase value.
:I	Write the Instantaneous value.
:F	Write the DFT magnitude for the specified Harmonic. For example, ^6:F0 writes the DFT Magnitude of the DC Offset for channel 6 and ^6:F2 writes the DFT Magnitude of the 2nd Harmonic for channel 6.
:D	Write the Duration of the Fault.
:H	Write the value DC Offset divided by the fundamental. Indicates a pegged channel.
:X	Write the CT ratio.
:Y	Write the PT ratio.
:Z	Write the frequency.
:W	Write the megawatts.
:V	Write the megavars.
:%	Write the Percentage of Nominal from the Prefault bar to the Fault bar.
:%v	Measures voltage sag immunity.
:+	Write the channels maximum value.
:-	Write the channels minimum value.
:Number	Specifies the width of the analog data values. Will only be applied if the defined width is greater than the length of the data values. Spaces are padded to the beginning of the written values. This is used to right justify values.

:S	The skew of the 3 analog channels using the angles. The S command is used with 3 analog channels <1,2,3:S>. This command adds the 3 angles at the cursor. One of the channels must be marked as a reference channel.
:B	The Unbalanced Value for 3 Channels. The B command is used with 3 analog channels <1,2,3:B>. This command finds the highest and lowest DFT magnitude of the 3 channels. The result is the highest – lowest.
:N	The Negative Sequence for 3 Channels. The N command is used with 3 analog channels <^1,^2,^3:N>. This command computes the negative sequence for the 3 current or voltage channels in position 1, 2 and 3 on the screen. The magnitude for the negative sequence result is displayed.
:Q	The Positive Sequence for 3 Channels. The Q command is used with 3 analog channels <^1,^2,^3:Q>. This command computes the positive sequence for the 3 current or voltage channels in position 1, 2 and 3 on the screen. The magnitude for the positive sequence result is displayed.
:M	The M command is used for an entire channel. It calculates the maximum value of the channel minus the minimum value of the channel divided by 2 ((max-min)/2), <^1:M>. Since the command is not sample based both types of brackets can be used (<>,[]).
:SG100 :BL50 :NG5000 :ML700	The letter G or L followed by a number after the :S, :B, :M or :N defines a trigger. The letter G stands for greater than and L is less than. If the result is true than Alarm is displayed else Normal is displayed.

Example Analog Commands

<1>	Writes the visible analog column data at the date bar separated by commas for Channel 1.
<^1>	Writes the visible analog column data separated by commas for the Channel in position 1.
<1:R>	Writes the RMS value at the data bar for Channel 1.
<2:T>	Writes the Channel Title for Channel 2.
<^3:U>	Writes the Channel Unit for the Channel in position 3.
<4:P>	Writes the Phase value for channel 4.
<^5:I>	Writes the Instantaneous value for the Channel in position 5.
<6:F>	Writes the DFT magnitude for Channel 6.
[^1]	Writes the visible analog column data at the reference bar separated by commas for Channel 1.
<^1,^2,^3:S>	Writes the sum of the angles at the cursor bar. One of the 3 channels must be marked as a reference channel.
[^1,^2,^3:B]	Writes the difference between the highest and lowest DFT magnitude at the reference bar.
<^1,^2,^3:N:6>	Writes the negative
<^1,^2,^3:NG2000:7>	Writes Alarm if the negative sequence of the 3 channels in position 1, 2 and 3 is greater than 2000, if it is not greater than it writes Normal.
<^1,^2,^3:NL500:7>	Writes Alarm if the negative sequence of the 3 channels in position 1, 2 and 3 is less than 500, if it is not less than it writes Normal.

Digital Commands

B1:T	Writes the Breaker 1 Digital Channel Trigger Information as defined in the Line Group as Breaker1=. The output text is the Digital Channel Title/Start Second:Milliseconds/Duration. If the Digital Channel started in Alarm state then NA is defined as the start date. If the Digital Channel started in Alarm state or ended in Alarm state then NA is written for the Duration.
B2:T	Writes the Breaker 2 Digital Channel Trigger Information as defined in the Line Group as Breaker2=. The output text is the Digital Channel Title/Start Second:Milliseconds/Duration. If the Digital Channel started in Alarm state then NA is defined as the start date. If the Digital Channel started in Alarm state or ended in

	Alarm state then NA is written for the Duration.
E1:T	Writes the Event 1 Digital Channel Trigger Information as defined in the Line Group as Event1=. The output text is the Digital Channel Title/Start Second:Milliseconds/Duration. If the Digital Channel started in Alarm state then NA is defined as the start date. If the Digital Channel started in Alarm state or ended in Alarm state then NA is written for the Duration.
B1:S	Writes A (Alarm) or N (No Alarm) indicating if the Breaker 1 Trigger status in the File.
E3:D	Writes the Event 3 Start Time
B1:E	Writes the total number of times the digital channel toggled.

When a carat ^ is specified before the channel number it indicates the channel position in the data plotting window. The < > characters saves the analog data at the data bar and the [ ] characters saves the analog data at the reference bar.

VALUE FILES

To create a new values file click the Clear button to clear the contents of the existing values file in the notepad editor, change the name of the file using the edit box or click the Browse button to create a new file, then click the Save button.

To write a template command to the values file, first position the data and/or the reference bar in the data plotting window then click the Mark button in the Mark and Save window or select the Mark Scan menu option under the Values menu in the data plotting window. You can also use the shortcut keys Ctrl-S to mark an analog scan in the data plotting window. Each command will be appended to the values notepad window. Click the Save button to save any changes to the template and values file.

To navigate to the next Marked Scan in the data plotting window select the Next Marked Scan menu option under the Values menu or use the shortcut keys Ctrl-X to navigate to the next Marked Scan.

The analog commands listed in the Template file section specifies what values to write to the values file. If the analog channel commands defined in the active template file does not specify a specific data value then all the analog columns visible will be saved with each command separated by commas. For example if the analog channel command is <1> and the INST, RMS and PHASE columns are visible then it will write the INST,RMS,PHASE values for Channel 1.

If a specific analog channel is defined in the template file with no data value indicated and the channel is not visible then that template command is ignored.

When a template command is written to the values file editor a red upside-down T is displayed above the analog scan in the data display window. To clear the red marks from the data display window select the Clear Marks icon under the Waveform tab.

MARK SCAN

To mark a scan, place the data bar at the desired scan then select the Mark Scan icon under the Waveform tab or press Ctrl-S. Marked scans are tagged with an upside-down red T at the top of the scan. Scans are also marked when the Mark button is clicked in the Mark & Save dialog. Marked scans are useful for navigating large amounts of data. To quickly navigate through the marked scans select the Next Marked Scan icon under the Waveform tab or press Ctrl-X. To clear the marked scans, select the Clear Marks icon under the Waveform tab. Marked scans can also be tagged with a comment. Refer to the next section for more information on assigning a comment to each scan.

EDIT MARKED SCANS

To assign a comment to each marked scan select the Edit Marks icon under the Waveform tab. The edit marked scans dialog is displayed. The dialog lists each marked scan in a table with the following columns:

Scan Sample Number – Displays the Scan Sample number with a checkbox to the left of the Sample #.
Date & Time – Displays the date and time of the scan.
Comments – Allows for entering a comment for each Marked Scan.

The assigned comment can be viewed in the analysis window by placing the mouse over the scan's upside-down red T indicator at the top of the window. The comment is displayed in a hint window.

To delete a scan click the checkbox in front of the scan then click the Delete button.

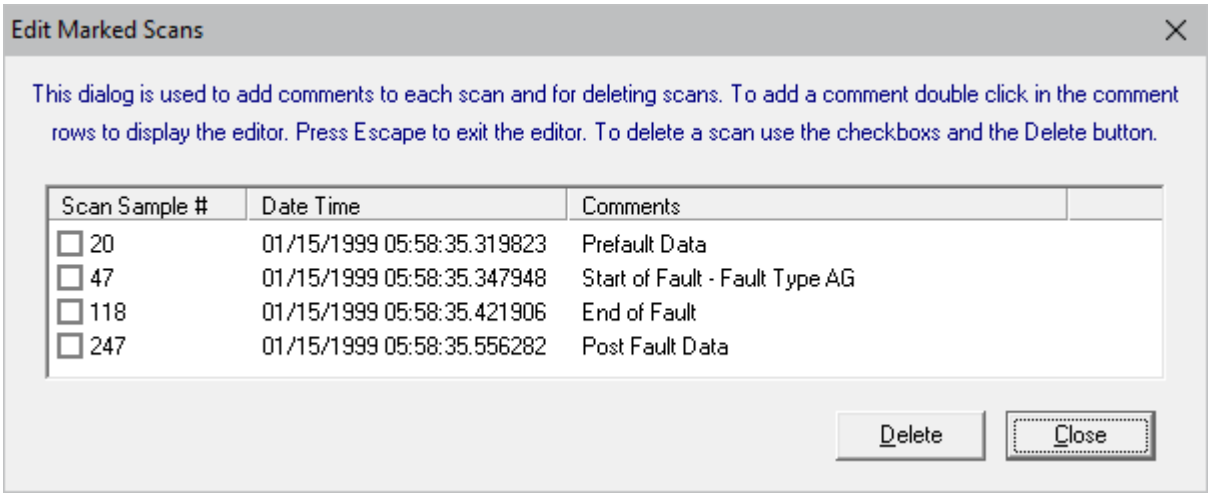


Figure 3.14 Edit Marked Scans

MARKING, DELETING, AND RESTORING CHANNELS

To mark or unmark a channel, mouse click on the channel ID or channel title, or use the space bar. To mark a group of channels click on the first channel then shift click on the last channel. Marked channels are displayed in red.

To mark/unmark all analog and digital channels press the F8 key or select the Mark/UnMark All icon under the Channels tab. If no channels are marked, all of the analog and digital channels will be marked. If any channels are marked, all of the channels will be unmarked. To mark/unmark all the analog channels select the Analog Un/Mark icon under the Channels tab. To mark/unmark all of the digital channels select the Digital Un/Mark icon under the Channels tab.

Channels must be marked to delete them from the display window. The Delete key removes the marked channels and the Insert key restores all the deleted channels.

SCALING ANALOG CHANNELS

When the analysis display is first opened, all the analog channels are scaled according to the channel's units. To scale the channels according to the maximum space allocated for display, press F6 or click the AutoScale icon. This option toggles among the four views: On, Off, ++ and Units. The active auto scale state is displayed in the "AS" status field. Each view is defined below:

- **ON** – The On view plots the channel data scaled to the maximum value allocated along the zero-reference line.

- **OFF** – The Off view plots all of the channels that are scaled to the maximum value in the display.
- **++** - The ++ view plots the signal using the number of maximum pixels allocated for the channel. The highest value is plotted at the maximum position and the smallest value is plotted at the lowest position. This feature was added to clearly show the profile of a frequency channel, a Vdc channel and load data channels.
- **Units –** The Units view plots the channels with reference to the maximum value allocated along the zero reference line for each group of channels with the same units.

To increase or decrease a channel's amplitude, along with the phasors and circular chart first mark the channels then click the AmpUp or AmpDn menus buttons or use the ctrl+up/down arrow keys. The auto scale multiplier (ASM) is used to amplify or attenuate the channel's data values. For example, when the amplitude increases the ASM value is multiplied by the channel's current Trace Multiplier and when the amplitude decreases the ASM value is divided by the channel's current Trace Multiplier. The Trace Multiplier is located in the properties dialog under the Display Setting tab. This value is initially defaulted to 1.75. To increase/decrease only the analog channels amplitude, click the up and down arrow buttons located to the right of the data scroll bar. To increase/decrease only the phasor magnitude or circular chart click the up and down arrow buttons located in the phasor/circular chart header.

To increase or decrease the channel's time scale, click the Condense or Expand icons or press the ctrl+page up and ctrl+page down keys.

NOTE: If no channels are marked all the visible channels are scaled accordingly.

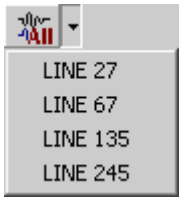
ZOOMING CHANNELS

To zoom in on specific analog or digital channels, first mark the channels then press <enter> or click the ViewMrks icon. The unmarked channels are removed from the display window and the marked channels are rescaled to fit in the window. To restore the hidden channels press the <esc> key, the <backspace> key, or click the ViewAll icon.

When returning to the original view all channels in the previous view remain marked for quick selection of additional channels for a new view.

SELECTING PREDEFINED VIEWS

The DFR Transcan and Faxtrax records have predefined views encoded into their format. To select the predefined views click on the "Show All/ Select View" drop down icon or select the Select View icon under the Waveform tab. A list of the available lines/graphs will be displayed. Click on the desired view. The analog channels defined in the select view will be displayed. To view all the analog channels in the file press the <esc> key, the <backspace>, or click the Show All icon or click the ViewAll button. To view user defined views refer to the User Views section.



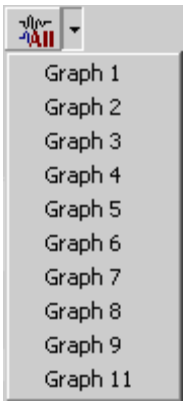


Figure 3.15 Predefined Lines **Figure 3.16 Predefined Graphs**

REPOSITIONING CHANNELS

Analog channels can be repositioned in the display window. To move an analog channel up one position mark the channel and press the "+" key or select Shift Up icon under the Channel tab. To move a channel down one position mark the channel and press the "-" key or select Shift Down icon under the Channel tab. To move a group of analog channels, mark all the desired channels then press the "+" or "-" keys.

The marked analog channels can also be moved by dragging the channels to a specific location in the display. To drag the analog channels to a new position move the mouse over one of the marked channels number or titles and drag to the specific position.

PRINTING WAVEFORM FILES

To print all of the data for the visible channels, select the All drop down option from the Print icon under the Waveform tab. The page numbers are located on the top right corner of each printout. The date and time of the first sample on each page is printed at the bottom left corner. To print only the data currently displayed in the data window click on the Page drop down option from the Print icon. To print a screen dump select the Window drop down option. Use the zoom feature to print only the selected channels. If the software cannot access the printer port, an error message is displayed.

SAVING AS COMTRADE

The visible analog and digital channels can be saved in the COMTRADE ASCII or Binary format. Three Comtrade versions are supported: the older 1991 format, the 1999 format and the newest 2013 format. The new 2013 Comtrade format can be saved as a single file with the CFG, HDR and DAT all contained in a single file. The new Comtrade single file format has a .CFF extension. The default format is the 1999 ASCII format.

Mark the analog and digital channels to save and press <enter> or click the ViewMrks icon  . To create a COMTRADE file select the Save As icon under the Waveform tab. Enter the destination path and filename (do not enter the filename extension) and click OK. The ".DAT" and ".CFG" files or the ".CFF" file are automatically created. If a path is not defined, the COMTRADE files are saved in the active directory in the File Manager.

To automatically name the Comtrade file using the IEEE long file naming format check the Use the ComNames Naming Convention to Name the Comtrade File(s) check box in the Save As dialog and leave the File Name field empty. The selected channels are converted to the specified Comtrade format and are named using the IEEE long file naming convention.

If the sample values in the displayed file are RMS calibrated and the outcome Comtrade file must have instantaneous values, set the Comtrade Settings fields to automatically convert the RMS data to instantaneous values. To set the Comtrade Settings fields open the Properties dialog. Select the Comtrade tab then select "Yes" for the Convert RMS Calibrated Data to Peak Data field.

If the line impedance values and line length are available in the original file then Wavewin will save the line impedance values to the .HDR file or in the .HDR section in the .CFF format. Below is an example of the information Wavewin saves in the header section of the Comtrade single file (.CFF).

```
--- file type: HDR ---
Fault Information
01 - Event: BG  Location:    0.90  Shot:    Frequency:  60.03
     Targets:
     Currents (A Pri), ABCPGQ:    332  3660   316     2  3596  3580
     Line Len:  3.08
```

```
Impedance Values
Z1Mag = 2.84
Z1Ang = 66.65
Z0Mag = 8.81
Z0Ang = 68.67
LL = 3.08
```

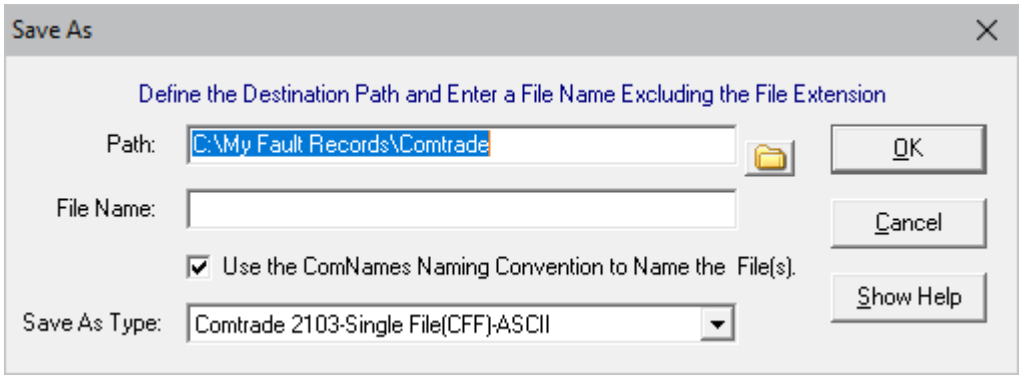


Figure 3.17 Save As COMTRADE

VIEWING ANALOG DATA

The values displayed in the analog view can be presented in tabular form (analog table) or in a concentrated form (combination view). Press F4 to toggle between the two views. The concentrated view can only be displayed if there is enough room to display 2 lines of data values between each channel. To navigate through the analog table columns use the View button (located to the right of the analog table headers) or the shift-right/left arrow keys. To close the analog table, click the Close button located in the header. Valid analog channels are displayed in the left portion of the window and the analog information in the center table. An analog channel is marked as invalid if the title is empty, or it contains any of the following strings in the beginning of the title.

- UNUSE
- UNDEF
- NOT D
- NOT U
- NOT I
- NAT A
- UNDEF
- {
- N/A
- ANALOG INPUT
- ANALOG CHANNEL
- EXTERNAL INPUT
- EVENT CHANNEL
- CHANNEL
- DIGITAL TRACE #
- SPARE

To show an invalid channel use the Show/Hide Channel Title dialog in the file manager. Refer to the Show/Hide Channel Title section for usage.

To make changes to the Analog and Digital views before opening a file, select the Display dialog located under the Options tab in the File Manager. Click on the Data Plotting tab. The table below explains each field available.

Field	Description
Open View	The Open View field when set to Yes will automatically open the first View located under the View  drop down list.
Analog Table Font Size	Change the size of the font in the Analog Table. The options are 8, 9, 10, 11, 12, 14, and 16. The default is size 8.
Digital Toggle Channels	The Digital Toggle Channels option will only display the digital channels that have a change of state if set to Yes.
Open Files w/ Primary Values	The Open Files w/ Primary Values option will open all files with Primary Values if the Primary and Secondary values are in the data file.
Process Type	When processing batch files there are two ways the files can be processed, renaming each filename that was processed by adding a ,WWD to the end of the filename or by the save date of the file. If the save date is used the system first bins all the files to process then sorts them according to the earliest save date. The last save date processed is saved to the Wavewin.ini file. If a save date is in the Wavewin.ini then all files to be processed will start after the save date a time saved in the Wavewin.ini file.
Batch Files	When processing batch files (see the Auto Process Template section in the File Manager Quick Start) it will process all files or just the new files. When a file is processed a WWD is appended at the end of the filename. This indicates the file has been processed and it will not be re-processed if New Files is selected.
Start DT	Enter the Start Date and Time when processing files using the By Save Date selected in the Process Type field.
Versioning	The Versioning field applies to line group files. If a line group file exists (.LNG) then when a data file is open it will create an LPG file with the same name as the data file. This preserves the line group data for each data file.
Process #	Select the number of files to process for each run. The range is 1 to 256.
PDF Files	When the process templates engine processes a file a PDF screen dump and summary can be created for all the files, none of the files are just the files that had a breaker operate. Select the desired option from the drop down list.
Convert	If the files being processed in the process template engine have a date and time in UTC time this field will convert the UTC time to local time.
Duration Calculation – Current	The Duration Calculation Current fields allows for modifying the duration calculation. The duration is calculated for each current and voltage channel when the file is open. The current calculation is: If the 1st full cycle RMS value is less than set value (default = 100) then set the Trigger value to 500 else set the Trigger value to the set value (default = 5) multiplied by the 1st full cycle RMS values.
Duration Calculation – Voltage	The Duration Calculation Voltage fields allows for modifying the duration calculation. The duration is calculated for each

	current and voltage channel when the file is open. The voltage calculation is: If the 1st full cycle RMS value is greater than set value (default = 40) then set the Trigger value to entered percentage (default = 15%) multiplied by the 1st full cycle RMS values.
Append ComNames Files	This option will append all like files when a single file is opened. All appended files will be displayed in the data plotting window. The files must be in the IEEE long file naming format. Like files means the files have the same station name and same device name in the file names and the channel titles match in the files,

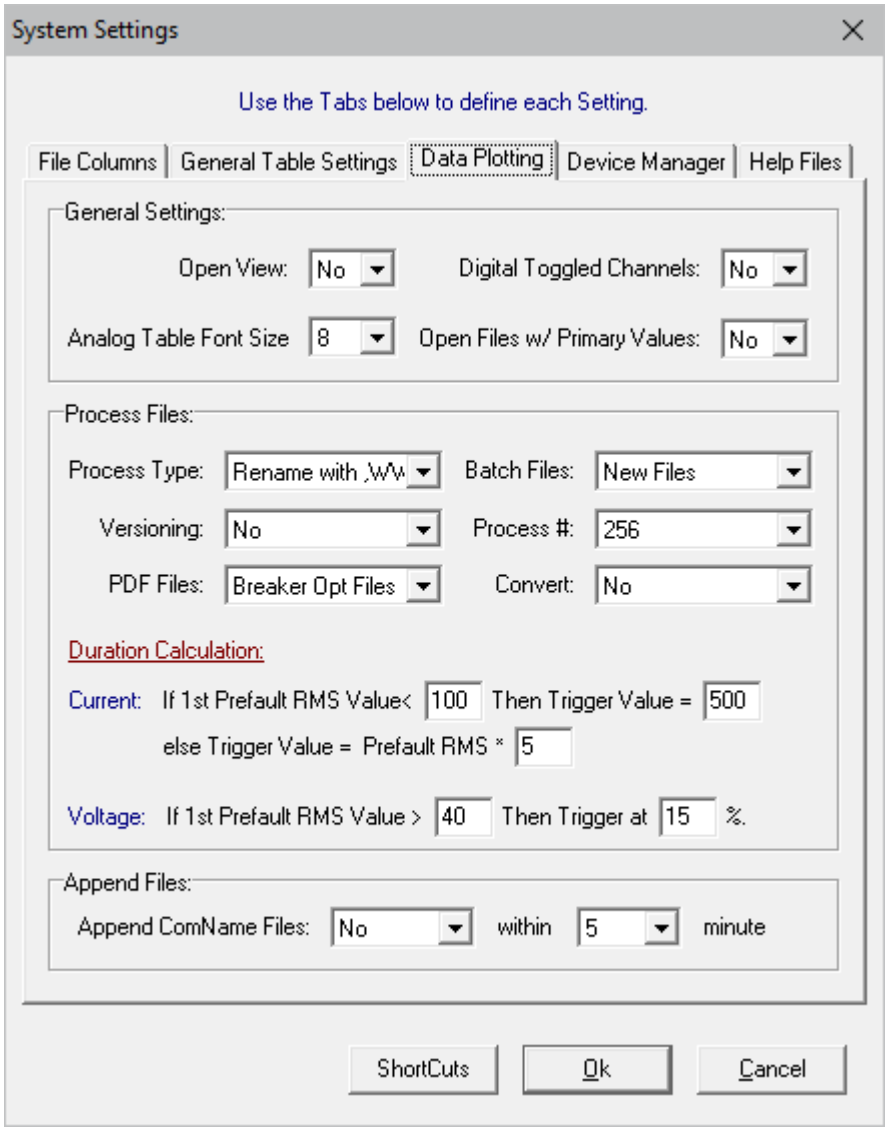


Figure 3.18 Data Display Properties

A maximum of 256 analog channels can be displayed in one window. The values displayed in the analog table and combination view are described below.

Analog Table View:

The analog table view is the default view. Use the view button  or the shift-right/left arrow keys to navigate through the columns of the table. The original sample values are plotted according to one of the following data types:

- Peak Type (No Multiplier)
- RMS Type (Root 2 Multiplier)
- Log files

All of the display drivers in the system are defaulted to peak to peak except the predefined log drivers. To change the settings for a driver select the Properties icon under the Waveform tab. Click on the Driver Data Type tab and select the type from the Data Multiplier Type drop down list. Periodic Log File's data type cannot be changed. To always open a certain display driver file with the RMS type, open the Driver Config dialog located in the File Manager's Options tab. Select the display driver in the list box then set its Driver Data Type to the desired option.

The following tables describe the analog data for the sinusoidal peak type, non-sinusoidal, and sinusoidal RMS data types:

Peak to Peak

Field	Description
Title	The analog channel titles.
RMS	The TrueRMS value is calculated by taking the summation of the square of all the sample values that are between the RMS bar (black dotted line) and the data bar. The result is divided by the total number of samples between the two bars and takes the square root of that result.
InstPeak	The highest absolute value of all of the samples between the two zero reference crossings surrounding the data bar (black solid line).
Phase	The phase angle of each channel.
InstVal	The sample value at the data bar (black solid line).
RefVal	The sample value at the reference bar (blue dotted line).
MaxPeak	The maximum peak value of the channel.
MinPeak	The minimum peak value of the channel.
Units	The analog channels prefix and units.
Scale	The value in units per inch or centimeters.
DFT Peak	The DFT Magnitude calculated between the RMS bar (black dotted line) and the data bar (solid data bar).
Crest	The DFTMag column divided by the RMS column.

Sinusoidal RMS Calibrated

Field	Description
Title	The analog channel titles.
RMS	The RMSVal column calculates an RMS value for all of the samples between the RMS bar (black dotted line) and the data bar (black solid line). Since the data is RMS calibrated each sample value is multiplied by the square root of 2 before it is squared.
InstPeak	The square root of 2 multiplied by the peak value measured between the two reference crossings surrounding the data bar (black solid line).
Phase	The phase angle of each channel.
InstVal	The RMS sample value at the data bar (black solid line) multiplied by Root 2.
RefVal	The RMS sample value at the reference bar (blue dotted line) multiplied by Root 2.
MaxPeak	The RMS maximum peak value of the channel multiplied by Root 2.

Field	Description
MinPeak	The RMS minimum peak value of the channel multiplied by Root 2.
Units	The analog channels prefix and units.
Scale	The value in units per inch or centimeters
DFT Peak	The DFT Magnitude calculated between the RMS bar (black dotted line) and the data bar (solid data bar).
Crest	The DFTMag column divided by the RMS column.

Non-Sinusoidal (Load Files)

Field	Description
Title	The analog channel titles.
MaxWin	The absolute maximum value between the sliding window bar (black dotted line) and the data bar (black solid line).
InstVal	The sample value at the data bar (black solid line).
RefVal	The sample value at the reference bar (blue dotted line).
MaxVal	The maximum value of the channel.
MinVal	The minimum value of the channel.
Units	The analog channels prefix and units.
Scale	The value in units per inch or centimeters
AvgWin	The average value of all of the samples between the sliding window bar (black dotted line) and the data bar (black solid line)

Combination View:
The combination view shows all of the channel information in a signal view. This view is only available if there is sufficient room between analog channels to display two or more lines of text.

Default Display format:

Peak to Peak:

Channel Title			
RMS	MaxPeak	RefVal	
InstVal	MinPeak	Units	ASV

RMS Calibrated:

Channel Title			
RMS	MaxPeak	RefVal	
InstVal	MinPeak	Units	ASV

Load Files:

Channel Title			
MaxWin	MaxVal	RefVal	
InstVal	MinVal	Units	ASV

The Instantaneous sample values are displayed in red when the data bar is on the channel's maximum value and displayed in blue when the data bar is on the channel's minimum value. Use the Tab key to toggle between the analog and digital channels. To hide the channel information, select the Analog Table icon under the Waveform tab.

The analog table and combination views can be resized by selecting the vertical separator bar and dragging it to the right or left. The mouse icon changes to the vertical resize cursor when the mouse is positioned over the separator bar.

To change how the analog data is displayed in the analog table and combination view select the Properties icon under the Waveform tab or click on the Properties  icon from the speed bar. The

Analog Table tab and the Analog Combination tab allows for changing the appearance of the analog information window.

Some of the functions of the Properties dialog are reordering, hiding, and showing the analog table columns; changing the data positions in the combination view; changing the background colors and trace colors; and for changing the driver's data type and trace/phasor scale multipliers.

VIEWING DIGITAL DATA

The default digital view consists of only the triggered digital channels, which are displayed at the bottom of the screen. Triggered digital channels are digital channel's that have a value different than the original state saved in the channel's definition file. If the field inside the Display dialog in the File Manager has the Digital Toggle Channel's field set to Yes then only the digital channels that change state are displayed. To view all of the digital channels press F9 or select the All-Digital icon under the Waveform tab. A maximum of 4096 digital channels are displayed in a window.

The digital trace is displayed as a thin black line when the sample value equals the original state defined in the displayed file and is displayed as a thick green line when the sample value differs from the original state. The color and spacing between the digital channels can be changed in the Properties dialog. The digital color is under the Color tab and the space between the digital is under the Display Settings tab. The Cursor State column in the digital table displays an "A" for Alarm and "N" for Normal or the SEL defined state. These values are set by comparing the sample value at the data bar with original state, "A" = different than original state, "N" = same as original state.

The digital information is displayed in tabular form. The data columns are described below:

Column Number	Description
1 – Cursor State	The digital state of the sample at the cursor position (A=Alarm, N=Normal).
2 – Title	The channel title, a maximum of 40 characters can be displayed.
3 – Fst	The digital state of the first sample (A=Alarm, N=Normal).
4 – Lst	The digital state of the last sample (A=Alarm, N=Normal).
5 – Fst-Change	The time the channel first changed state.
6 – Lst-Change	The time the channel last changed state.
7 – Changes	The number of times the channel-changed state.

Use the scroll bar or the up and down arrow keys to navigate through the digital channels and use the tab key to toggle between the analog and digital views. Digital channels can be moved up or down. To reposition digital channels first mark the channels using the mouse or the spacebar. Use the "+" key to move them up and the "–" key to move them down.

ANALOG CHANNEL SCALE

The analog table displays the channels scale in inches or centimeters with respect to the units of the channel. The analog table column is Scale. The scale value is adjusted according to the current auto scale mode, OFF, ON, ++ or Units and is adjusted when the channel's amplitude is increased or decreased.

In auto scale mode OFF the scale is equal to the maximum value in the display. In auto scale mode ON the scale is set to the channel's maximum value allocated for display from the zero reference line. In auto scale mode ++ the scale uses the channel's maximum and minimum values allocated for display, ignoring the zero reference line. In Units mode all channels are scaled according to the maximum and minimum values for each group of channels with the same units.

CUSTOMIZING THE ANALYSIS DISPLAY

The Properties icon under the Waveform tab allows for customizing the analysis display window. Below is a definition of each tab:

- **Analog Table** – The Analog Table tab is used to reorder, hide, and show the columns in the Analog Table.
- **Analog Combination** – The Analog Combination tab is used to change the position of the data values in the Combination view.
- **Comtrade** – The Comtrade tab is used to define the Comtrade format for saving, the date and time format for display and for setting automatic conversion from RMS data to Peak data when using the Save As feature. It also allow for converting UTC to local time to support the new 2013 Comtrade format,
- **Colors** – The Colors tab is used to define the background colors of each display section and to set the default analog and digital channel colors.
- **Display Settings** – The Display Settings tab is used to define the Scale Multiplier for the traces and phasor/circular chart scaling. It also can define general display information for the window such as: setting the display trace type (sample based or time based), defining the Phase Angle Convention (Sine or Cosine), showing the time reference bar between the analog channels and the digital channels, showing the separator bar between multiple events displayed in one window, showing or hiding the fault bar (red dotted vertical bar), and defining the option to reference angles across windows when Sync mode is active. When “Yes” is defined for reference angles across windows all phase angles for the currently opened windows will be referenced from the first marked channel in the active window.
- **Append / Merge** – The Append/Merge tab is used to define from which file the samples will be discarded from when the discard common times option is used. It also is used to determine whether the station name should be added to the analog/digital titles when an append/merge option is executed.
- **Driver Data Type** – The Driver Date type tab is used to define the type of data that is saved to the displayed device’s data file: RMS Type or Peak Type, convert the analog sample values between primary and secondary and for editing the ratio values and for changing the line impedance values from primary and secondary.
- **Filters** – The Filters tab is used to define if spikes detected in the data file should be ignored when the maximum and minimum values are calculated and at what level they should be ignored.

To make changes to the Analog and Digital views before opening a file, select the Display dialog located under the Options tab in the File Manager. Click on the Data Plotting tab. The table below explains each field available.

Field	Description
Open View	The Open View field when set to Yes will automatically open the first View located under the View  drop down list.
Analog Table Font Size	Change the size of the font in the Analog Table. The options are 8, 9, 10, 11, 12, 14, and 16. The default is size 8.
Digital Toggle Channels	The Digital Toggle Channels option will only display the digital channels that have a change of state if set to Yes.

Open Files w/ Primary Values	The Open Files w/ Primary Values option will open all files with Primary Values if the Primary and Secondary values are in the data file.
Process Type	When processing batch files there are two ways the files can be processed, renaming each filename that was processed by adding a ,WWD to the end of the filename or by the save date of the file. If the save date is used the system first bins all the files to process then sorts them according to the earliest save date. The last save date processed is saved to the Wavewin.ini file. If a save date is in the Wavewin.ini then all files to be processed will start after the save date a time saved in the Wavewin.ini file.
Batch Files	When processing batch files (see the Auto Process Template section in the File Manager Quick Start) it will process all files or just the new files. When a file is processed a WWD is appended at the end of the filename. This indicates the file has been processed and it will not be re-processed if New Files is selected.
Start DT	Enter the Start Date and Time when processing files using the By Save Date selected in the Process Type field.
Versioning	The Versioning field applies to line group files. If a line group file exists (.LNG) then when a data file is open it will create an LPG file with the same name as the data file. This preserves the line group data for each data file.
Process #	Select the number of files to process for each run. The range is 1 to 256.
PDF Files	When the process templates engine processes a file a PDF screen dump and summary can be created for all the files, none of the files are just the files that had a breaker operate. Select the desired option from the drop down list.
Convert	If the files being processed in the process template engine have a date and time in UTC time this field will convert the UTC time to local time.
Duration Calculation – Current	The Duration Calculation Current fields allows for modifying the duration calculation. The duration is calculated for each current and voltage channel when the file is open. The current calculation is: If the 1st full cycle RMS value is less than set value (default = 100) then set the Trigger value to 500 else set the Trigger value to the set value (default = 5) multiplied by the 1st full cycle RMS values.
Duration Calculation – Voltage	The Duration Calculation Voltage fields allows for modifying the duration calculation. The duration is calculated for each current and voltage channel when the file is open. The voltage calculation is: If the 1st full cycle RMS value is greater than set value (default = 40) then set the Trigger value to entered percentage (default = 15%) multiplied by the 1st full cycle RMS values.
Append ComNames Files	This option will append all like files when a single file is opened. All appended files will be displayed in the data plotting window. The files must be in the IEEE long file naming format. Like files means the files have the same station name and same device name in the file names and the channel titles match in the files,

TIME & SAMPLE BASED DISPLAYS

The Trace Display Type field located in the Display Setting tab of the Properties dialog allows for toggling between the Time Based display and the Sample Based display. The sample based display plots the channel data with one pixel distance between each displayed sample. Sample based displays are useful for showing changes in sampling frequency. The time based display plots the channel data in time. Time based displays are useful for showing changes in line frequency.

To change the trace display type open the Properties dialog under the Waveform tab. Click the Display Settings tab and change the Trace Display Type field to time based or sample based.

FAULT REFERENCE TIME BAR

The Fault Reference Time Bar is displayed between the analog and the digital traces. It displays the time difference from the fault time defined in the displayed file. The units are displayed in the Delta X status field.

To toggle between the Timeline display and the Ruler display right click on the time bar and select from the pop up menu.

To show or hide the fault reference time bar open the Properties dialog under the Waveform tab. Click the Display Settings tab and select “Yes” or “No” for the Show Reference Time Bar field.

SUPERIMPOSING ANALOG CHANNELS

To superimpose two or more analog channels, mark the channels and press F7 or select the Super Impose On icon under the Data tab. Multiple groups of channels can be superimposed in one display. To superimpose the current channels mark the channels then press F7. The channels will automatically be unmarked after a superimpose operation. Next, mark the voltage channels and press F7. If no channels are marked and the channels are superimposed then all channels will be un-superimposed, Press F7 to turn this feature ON/OFF or select the Super Impose Off icon.

CHANGING ANALOG CHANNEL COLORS

To change the color of an analog channel, click the opposite mouse button on the channel ID. Select the channel color from the list or click More Colors to select from the color palette. Channels must be unmarked to change their colors.

SYNCHRONIZING DATA CURSORS

The Sync Data Cursors feature is used to synchronize the data bars for two or more display windows. To synchronize two or more data bars, open the files, select Tile Horizontal icon  from the main toolbar, then select the Sync drop down icon under the Data tab. This feature offers two sync functions: By Time and Manually. When a function is selected, the data bars in the non-active windows are moved to the synchronization point of the active window. The two functions are described below:

By Time
When the time function is activated, the data bars in the non-active windows are moved to the sample time of the data bar in the active window. For example, if the data bar in the active window is positioned on a sample at time 01:12:34.5600 all of the non-active data bars are moved to the sample at that time. If the time cannot be found the data bar does not move.

Manually
The manual sync function allows for the selection of different cursor positions in the windows before synchronization is activated. For example, open four display windows and tile horizontally. Move the data bar to the beginning of the fault cycle in each window and select the Manual cursor sync function.

Press the left arrow, right arrow, ctrl+left, ctrl+right, page up, page down, ctrl+page up, ctrl+page down, home and end keys or use the scrollbar or drag the triangle located under the data bar to move the data bars.

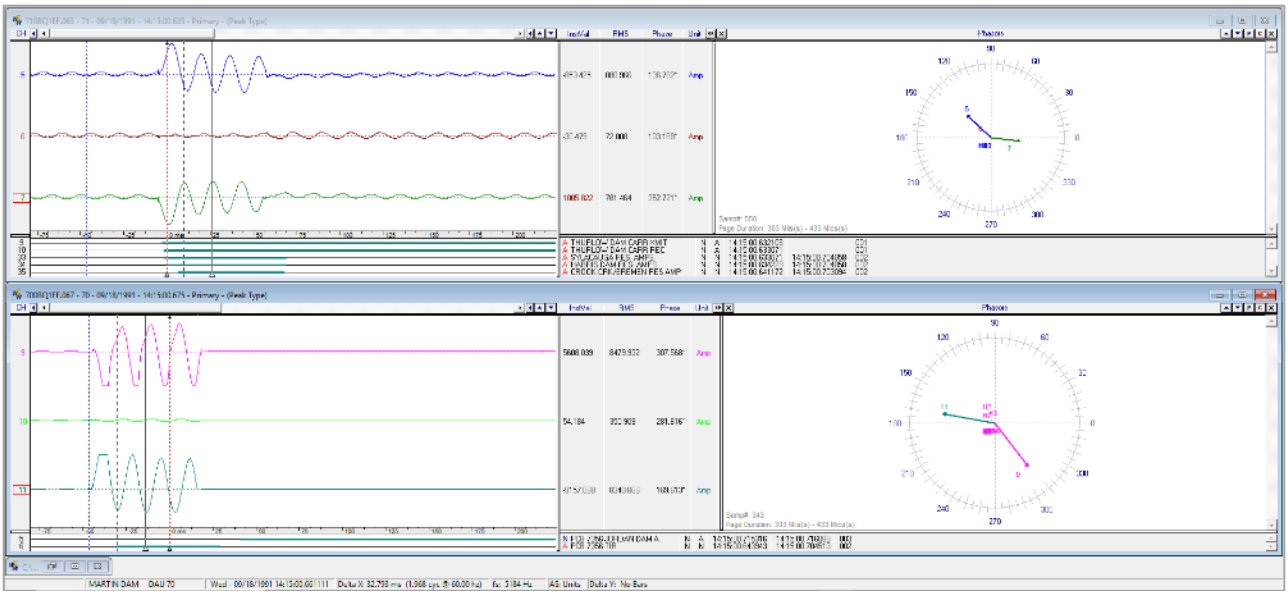


Figure 3.19 Cursor Synchronization

In Sync Mode, phase angles can be referenced across analysis display windows. The phase angles in the opened data windows are referenced by the first marked channel in the active data window. This feature is activated from the Properties dialog under the Display Setting tab in the Sync Mode section. Sync Mode must be active for the angles to be referenced.

APPEND OPEN FILES

The Append drop down icon under the Waveform tab appends all of the open windows into a new display window. There are two options available under the Append drop down icon:

- Discard Common Times: Any common times found in the open files will be deleted from the oldest file.
- Back to Back: The files are appended back to back. No samples are deleted.

When the system appends files it first finds the file with the oldest date and time. It then checks that all other opened files analog and digital channel titles and the scale factors for each analog channel match. If any of these do not match them the file is not included in the final appended display. When a file does not match a message box is displayed indicating the file will not be included in the waveform display.

MERGE OPEN FILES

The Merge drop down icon under the Waveform tab merges all of the displayed or marked channels into one display window. There are three options available under the Merge Open Files Menu:

- By Time: Merge channel samples if they have a common time segment. The reference time is taken from the file with the latest start date and time. The file with the least number of samples determines the length of the new merged file.

- Manually: Use the data bars to highlight the location of the common sample time in each window. Then Merge Manually will line up the data bars and adjust the time stamps accordingly. This option is used when the file times are not synchronized. The active window determines the time

stamp of the new merged file and the open window with the least number of samples determines the length of the new merged file.

- By Sample: Merge without regard to time stamps and/or data bar positions. The reference time is taken from the active window. The file with the least number of samples determines the length of the file.

When files with different sampling frequencies are merged a dialog will be displayed. The dialog contains a list of all the sampling frequencies in the opened files. Select the frequency for the merged file or enter a new frequency.

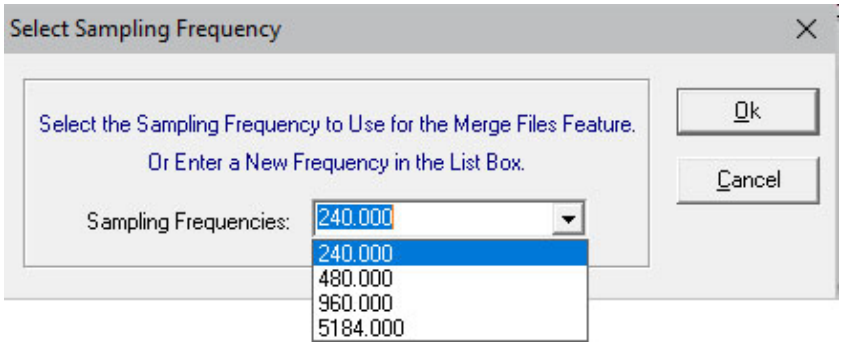


Figure 3.20 Merge Open Files: Select Frequency

Merging Open Files allows for flexibility of which channels are merged. Merge will merge the marked channels only, if there are no marked channels then it will merge the visible channels.

If the merged files have different data types (RMS Calibrated or Peak Values) the RMS values will be automatically converted to Peak values by multiplying the RMS values by Root 2.

To identify the merged channels the station name for each file is added to the beginning of the analog and digital channel titles. To turn this feature off open the Properties dialog  . Click on the Append/Merge tab and uncheck the Add the File's Station Name to Beginning of the Analog/Digital Channels field.

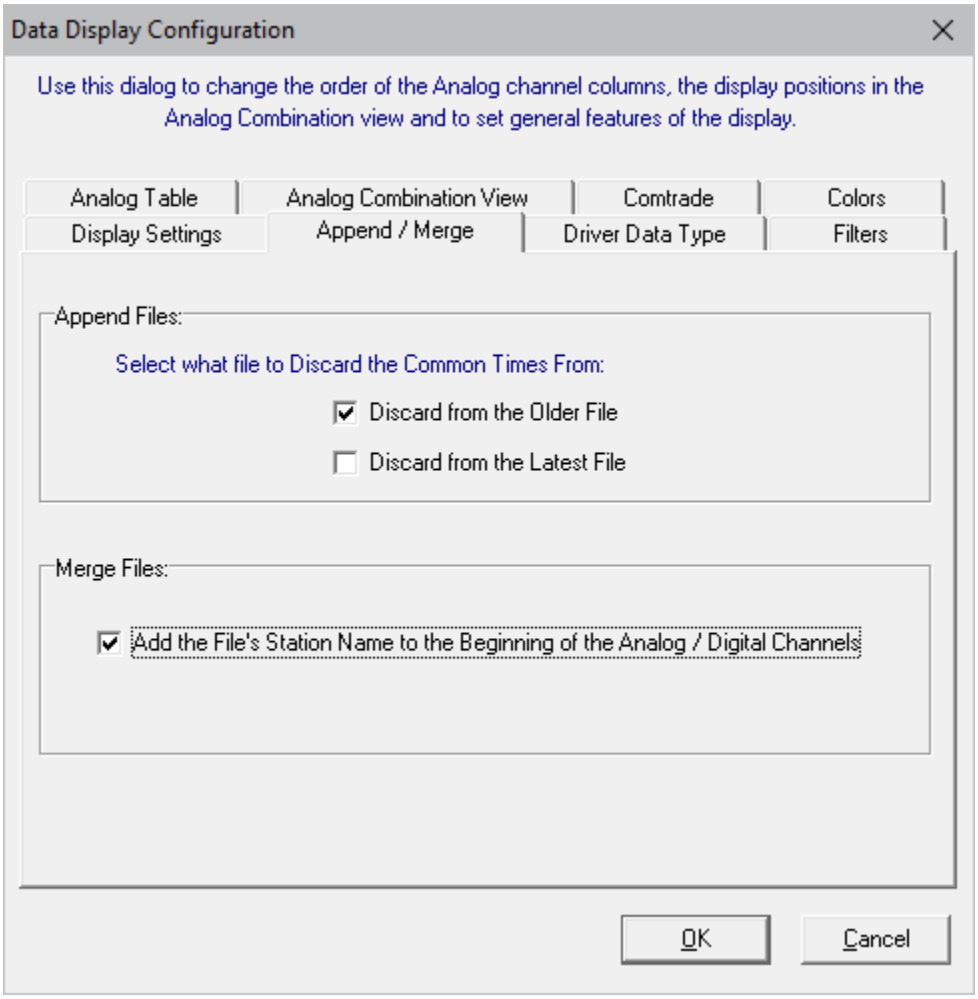


Figure 3.21 Append/Merge Properties

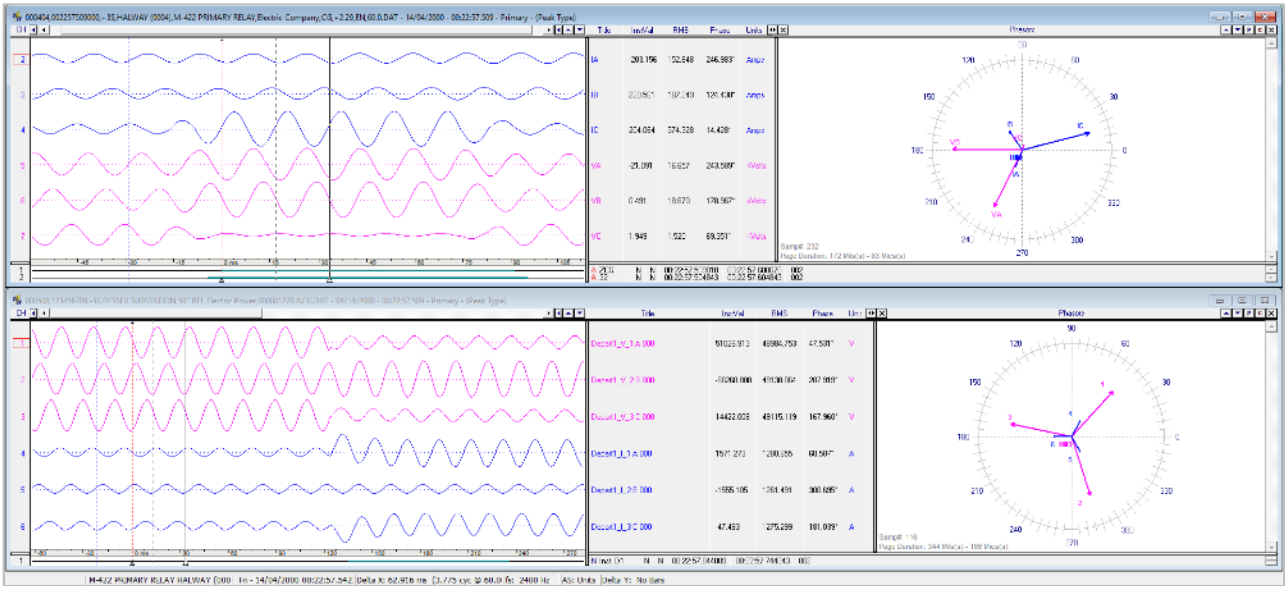


Figure 3.22 Merge Open Files – By Time: Open files and select channels to Merge

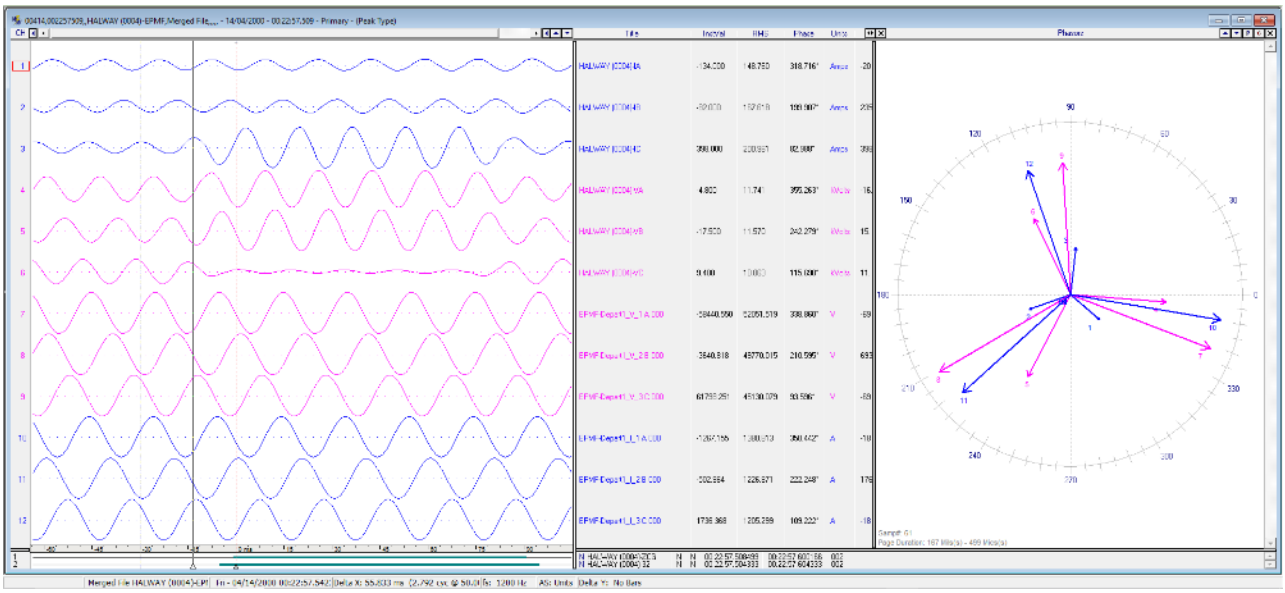


Figure 3.23 Merge Open Files – By Time: Result: By Time

Merge Open Files “By Time” will only merge the samples with common times. The reference time is the file with the latest start date and time.

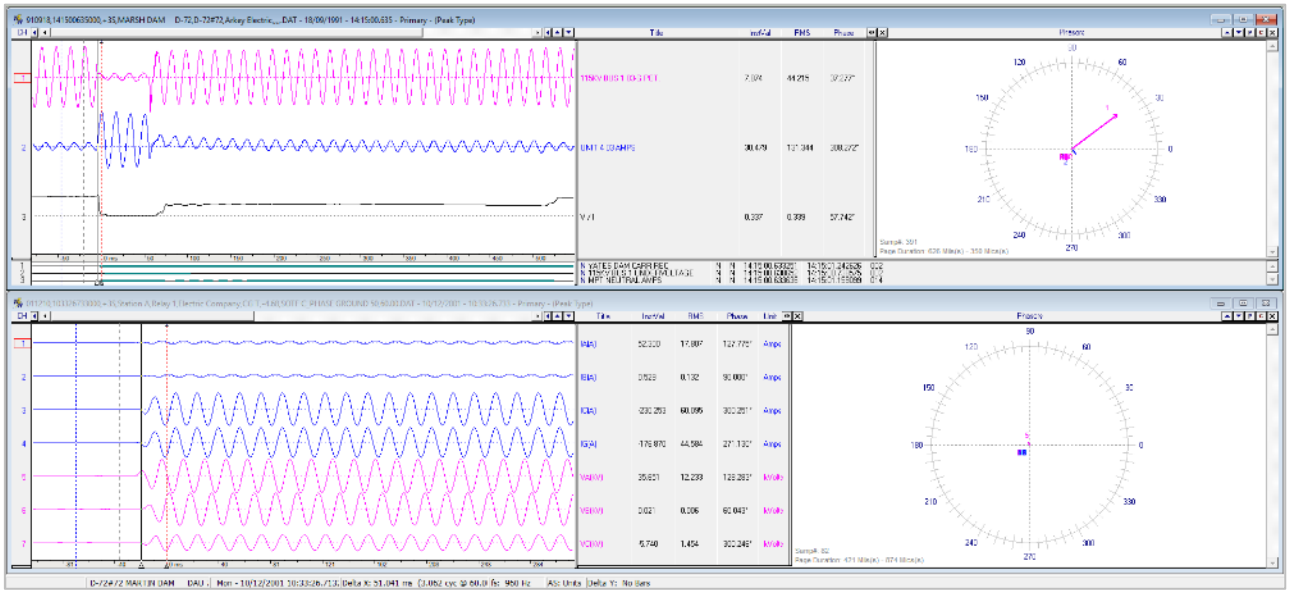


Figure 3.24 Merge Open Files – Manually: Select Channels & Position Data Bars

First, select the channels to merge by marking the channels and pressing the <enter> key. Next, position the data bars at the point representing the Same Point in time.

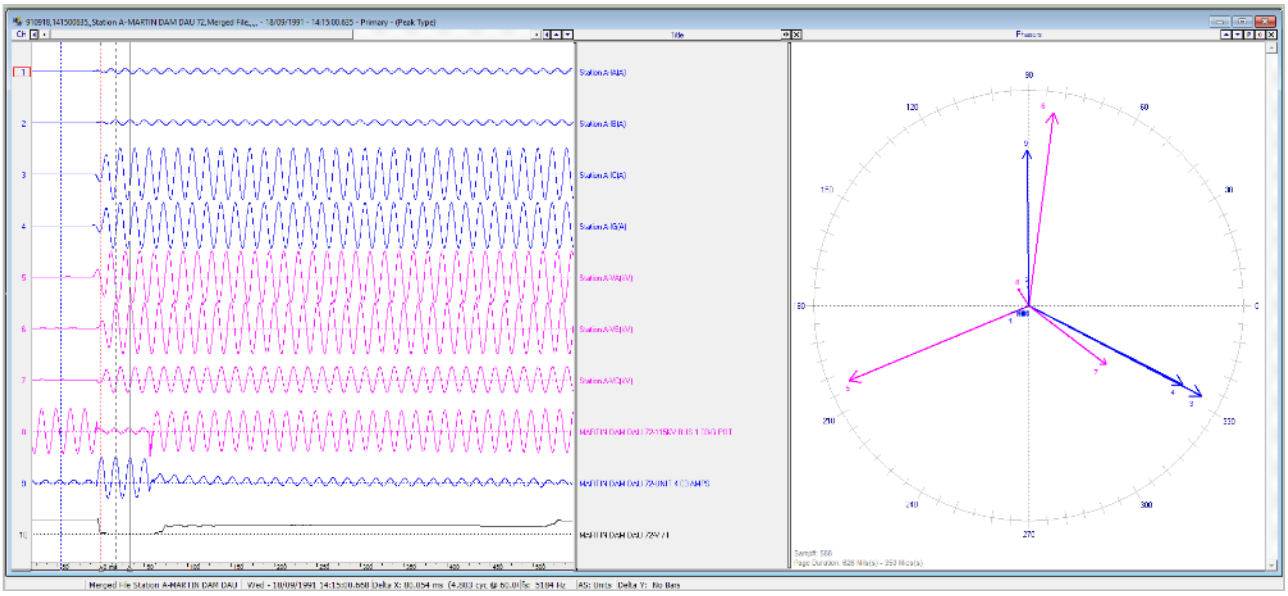


Figure 3.25 Merge Open Files – Result: Manually

Merge Open Files Manually is used when the file times are not synchronized. Place the data bars in the position where the times should be synchronized and merge the files. Merge will align the samples according to the position of the data bar in each open file. The data bar with the least number of samples at the beginning determines the number of samples to truncate from the beginning of all other open files. The active window's time stamp is used for the merged file and the open file with the least number of samples determines the length of the merged file.

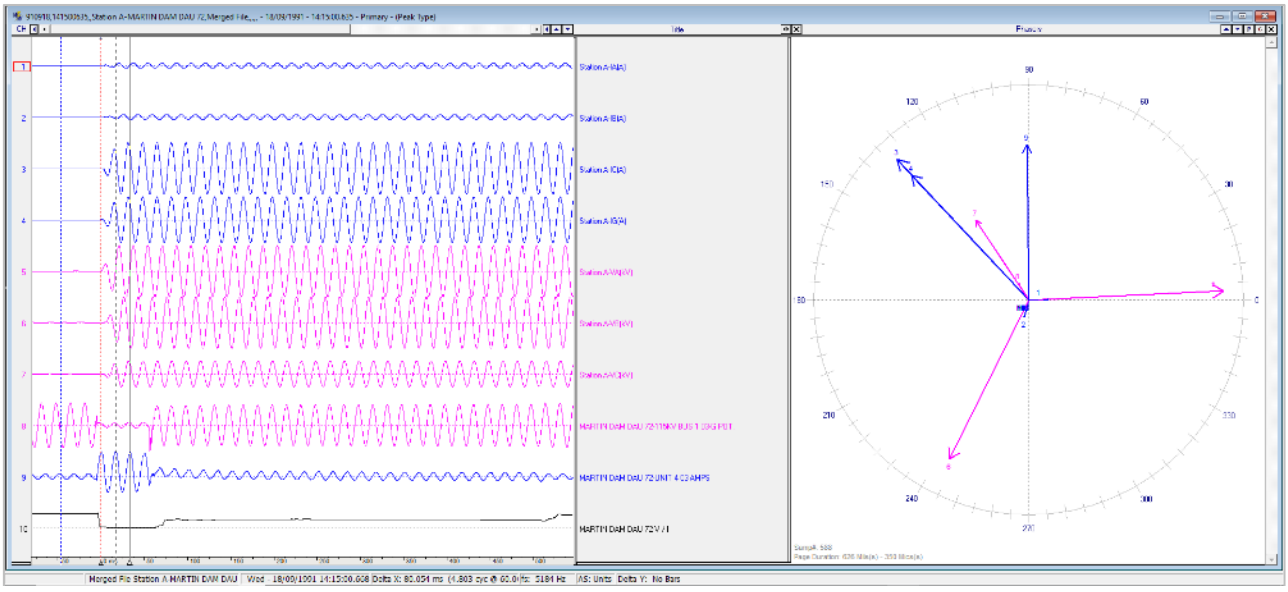


Figure 3.26 Merge Open Files – Result: By Sample (As Applied to Figure 3.23)

Merge Open Files "By Sample" merges without regard for time stamps and/or data bar positions. It merges "as is". The reference time is from the active window and the file with the least number of samples determines the length of the file.

CHANGE FREQUENCY

Change Frequency changes the current sampling frequency to the entered frequency. If the entered frequency is greater than the current frequency then samples are added. If the entered frequency is less than the current frequency then samples are deleted. The following screen dumps show an example that sets a multiple frequency file to a single frequency. The entered frequency must be greater than two times the line frequency.

Select the Sampling icon under the Data tab to open the change sampling frequency dialog.

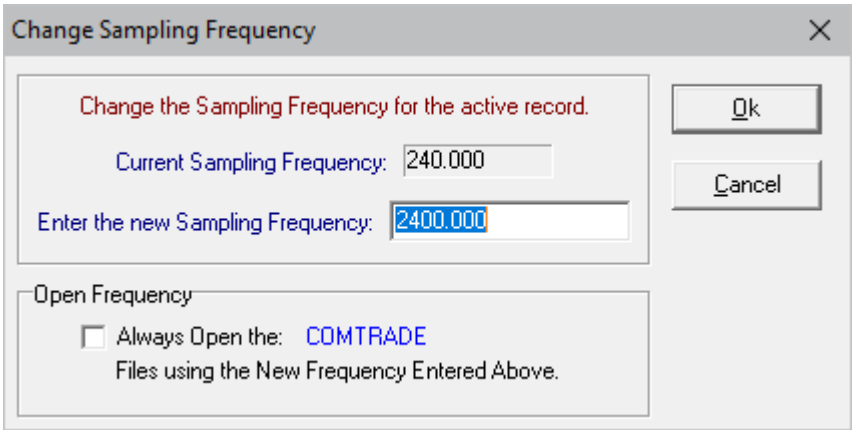


Figure 3.27 Change Frequency Dialog

It also allows for defaulting a driver to always display its' files using the entered frequency. For example, all SEL 4 samples/cycle (240fs) files can be set to automatically display 40 samples/cycle (2400fs).

NOTE: If Open Frequency is checked the Restore Original is not available.

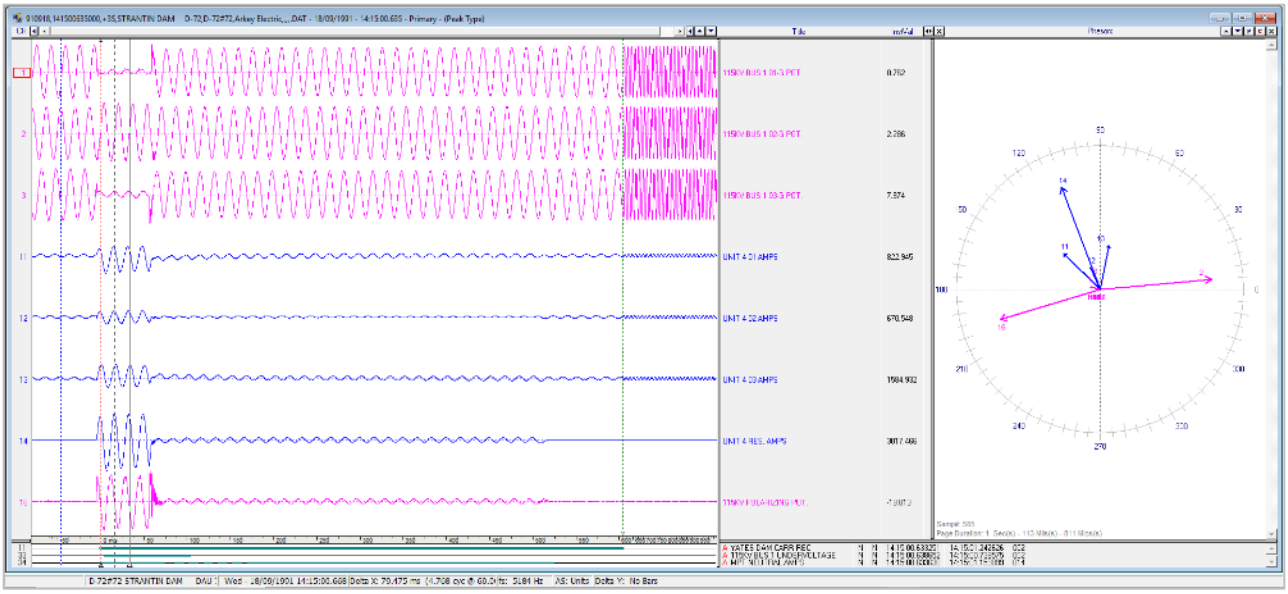


Figure 3.28 Change Frequency: Change a Mutiple Frequency File

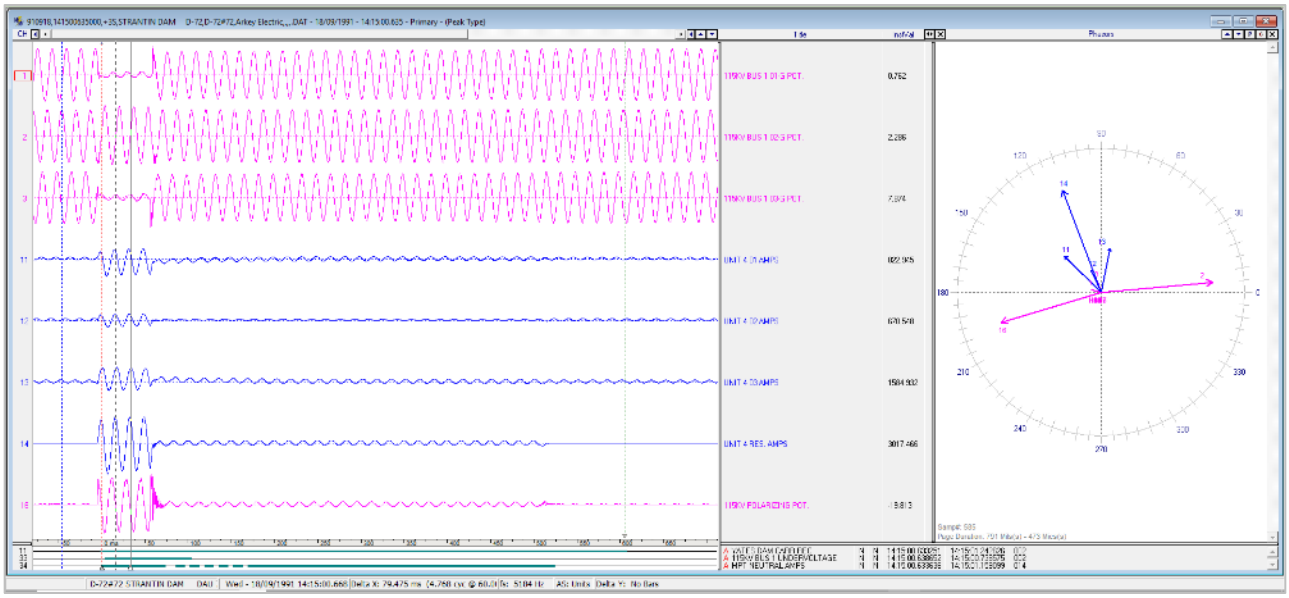


Figure 3.29 Change Frequency: Results

TRUNCATE CYCLES

Truncate Cycles removes the specified number of cycles from the analysis display. Three options are available under the Truncate drop down icon under the Data tab..

- Left: Remove all cycles from the first sample to the data bar.
- Right: Remove all cycles from the data bar to the last sample.
- Middle: Remove all cycles from the data bar to the reference bar (blue dotted line).

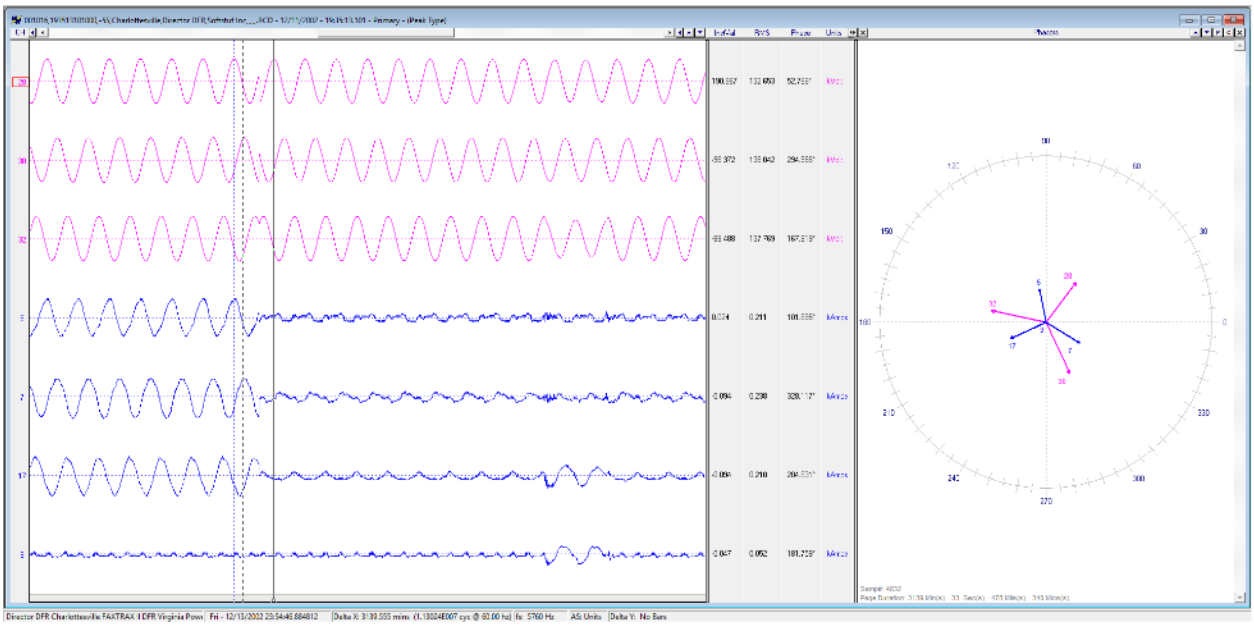


Figure 3.30 Truncate Cycles: Append Non Time Matching Waveforms

After appending two waveform files it may be necessary to truncate the cycle that did not match. First, align the reference bar on the peak before the appended position then align the data bar on the peak following the appended position and select the truncate middle menu option.

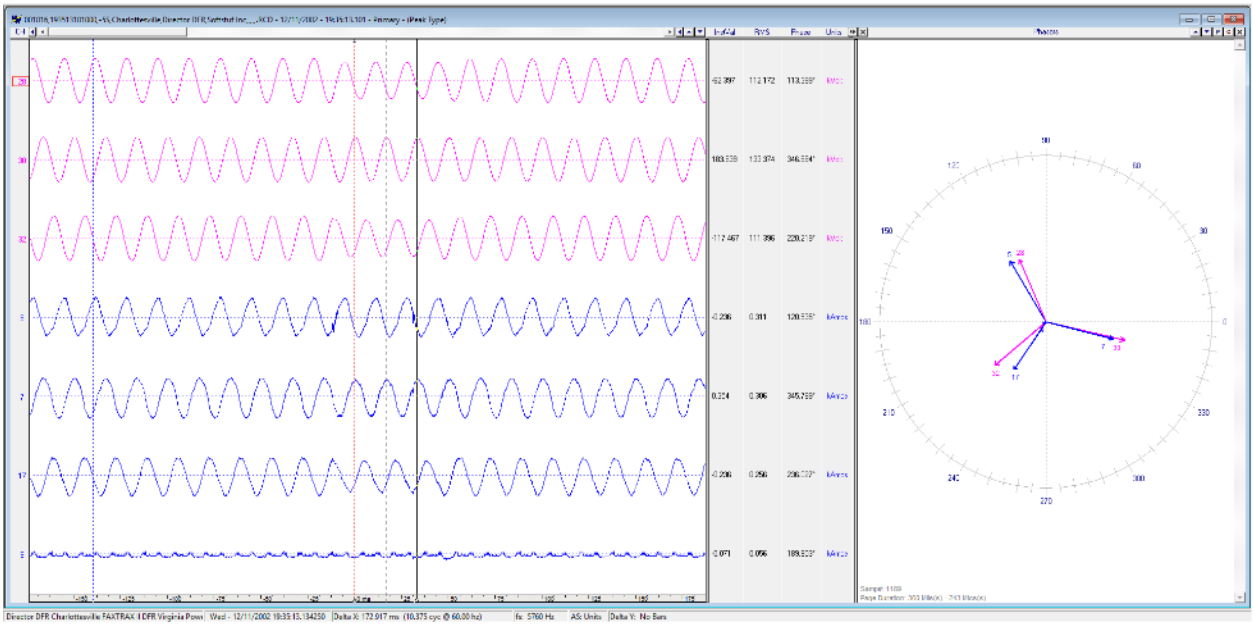


Figure 3.31 Truncate Cycles: Results

DUPLICATE CYCLES

The Duplicate Cycles dialog duplicates the cycle at the data bar by the number of times entered in the # Cycles field. This feature is useful for creating Comtrade files to play back to test set and for modeling and simulation applications. Refer to the following screen sumps for an example that adds five cycles of fault cycles to a file.

To open the Duplicates dialog select the Duplicate icon under the Data tab.

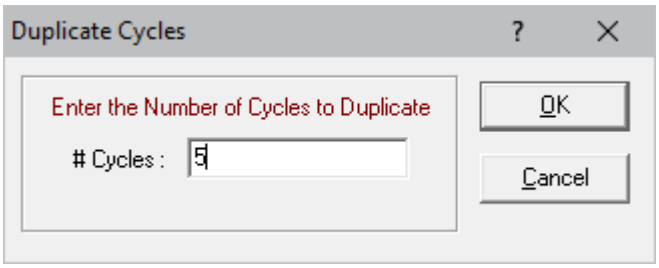


Figure 3.32 Duplicate Cycles Dialog

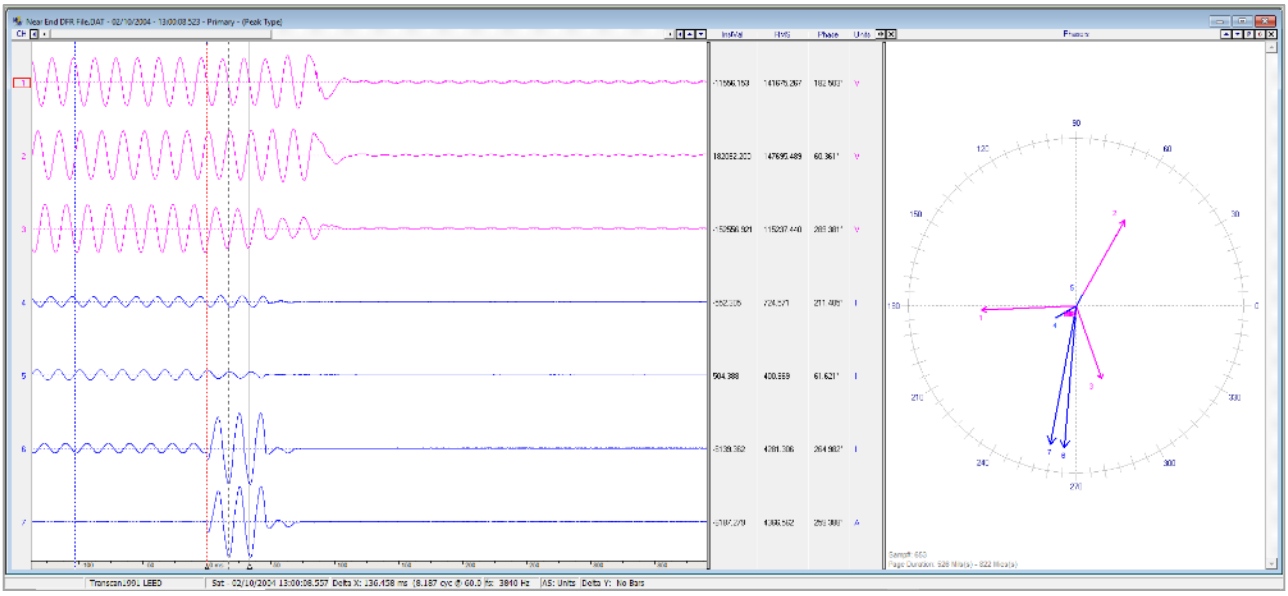


Figure 3.33 Duplicate Cycles: Initial File

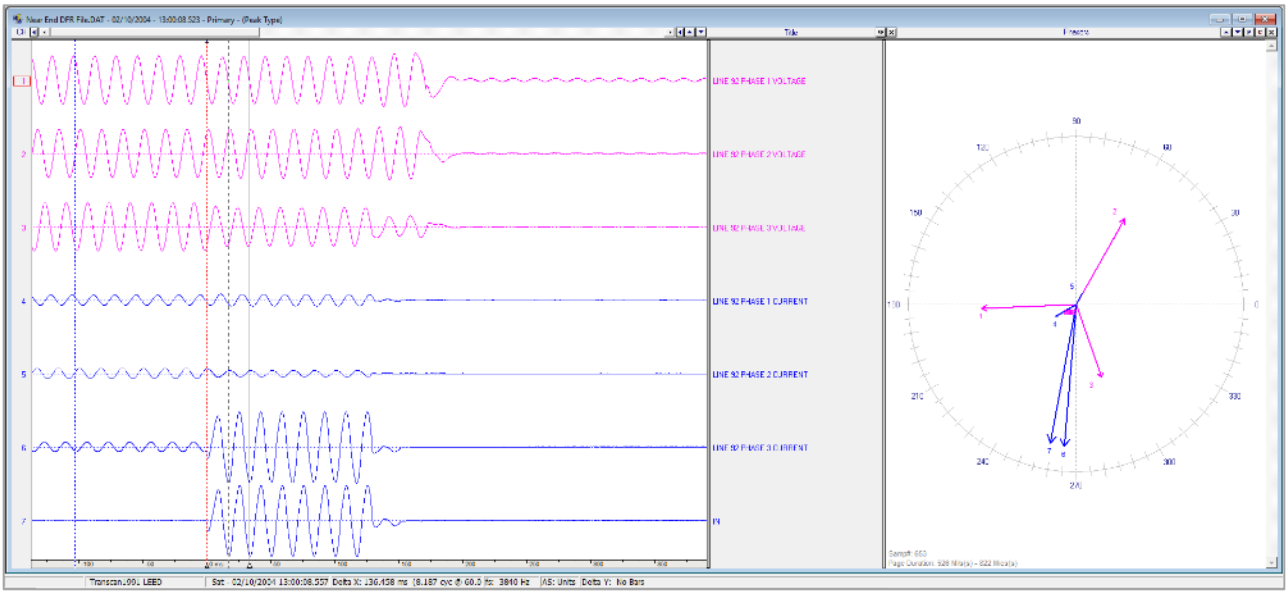


Figure 3.34 Duplicate Cycles: Add 5 Fault Cycles

RESTORE ORIGINAL DATA

Restore Original Data will reread and display the sample values from the active waveform file on disk. Any changes made to the analysis window, such as: duplicate cycles, change frequency and truncate cycles will be lost when this feature is activated. If the Open Frequency option is checked in the Change Frequency dialog the Restore Original is not available. To restore the display to the original samples in the file click on the Original icon under the Data tab.

MARK RAW VALUES

Mark Raw Values marks the raw values saved in the active waveform file on disk. A small hollow blue circle is placed at the raw value. This feature is helpful in highlighting the raw sample values saved in low sampling rate files. To mark the raw samples click on the Mark Raw icon under the Waveform tab.

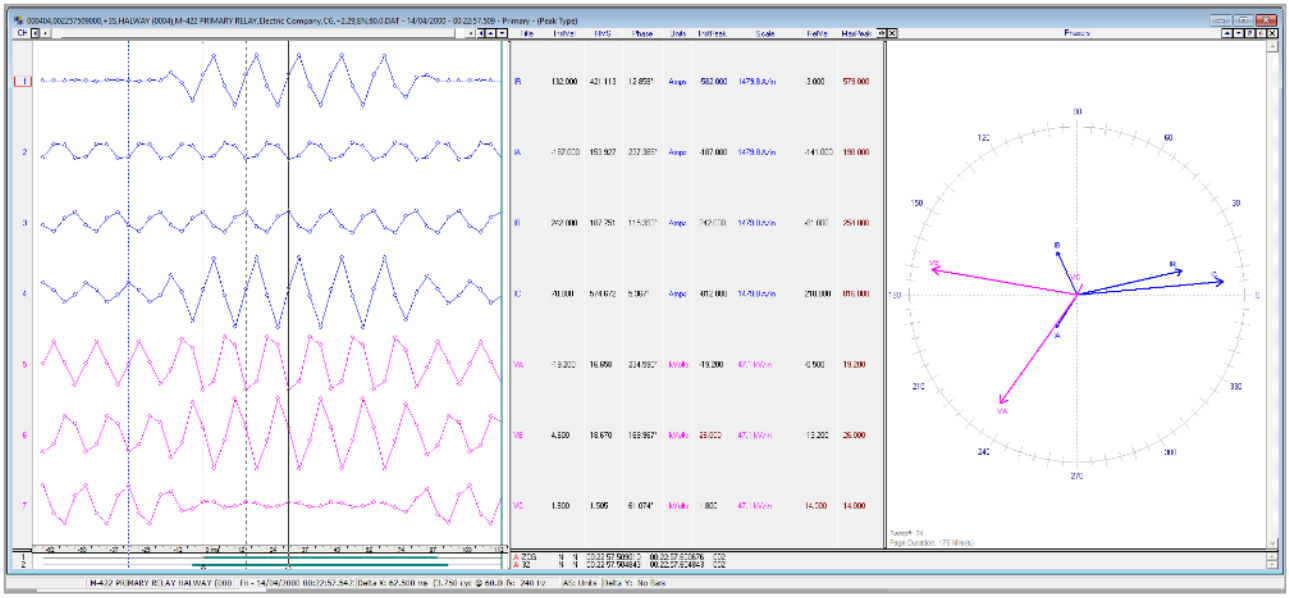


Figure 3.35 Mark Raw Values

MARK PEAK VALUES

Mark Peak Values marks the peak sample values for all visible analog channels. A small solid gray square is placed at the peak values. This feature is helpful in highlighting the positive and negative peak values. To mark the peaks click on the Mark Peaks icon under the Waveform tab.

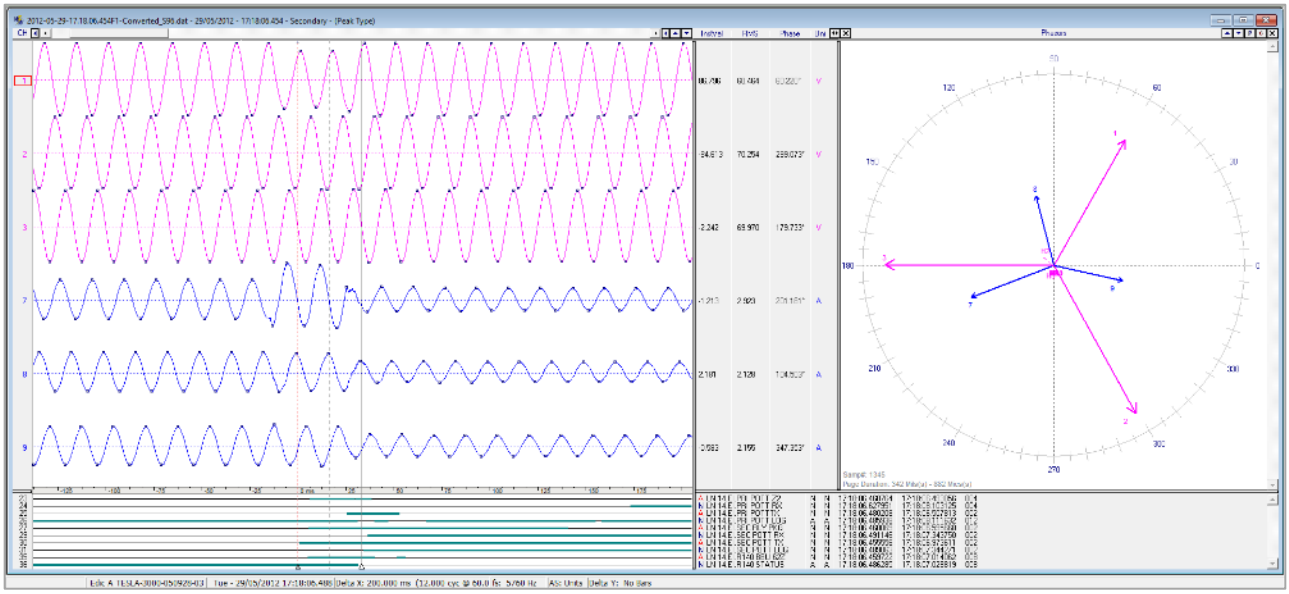


Figure 3.36 Mark Peak Values

MARK CHANGE IN SIGN VALUES

Mark Change In Sign marks all samples where a change in sign occurs. A small solid gray triangle is placed at the change position. This feature is helpful in highlighting the position where a change in sign occurs in the signal. To mark the change in sign positions click on the Mark Change icon under the Waveform tab.

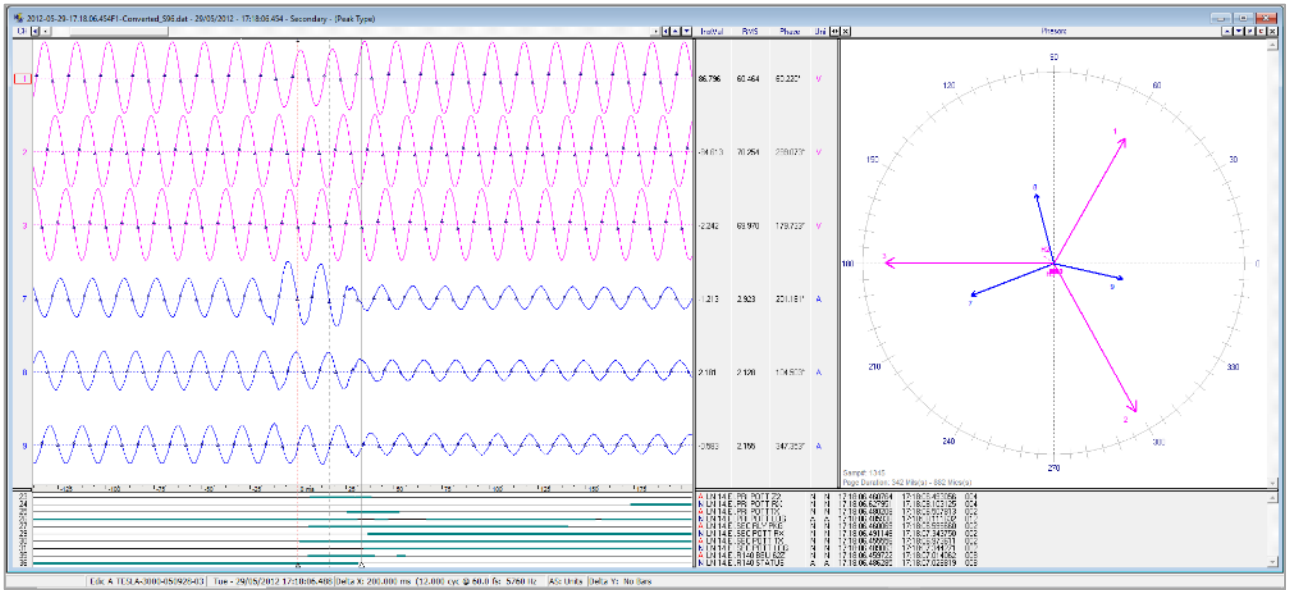


Figure 3.37 Mark Change in Sign

CHANGE ANALOG VALUES (PRIMARY ←→ SECONDARY)

The values displayed in the analog table are either in primary or secondary quantities. The analog quantities type is displayed in the window header. Also, if the CT and PT ratios are defined in the configuration file the values can be changed from primary to secondary and vice versa. To change the values open the properties dialog and click on the “Driver Data Type” tab and select the Primary or Secondary radio button to switch between values.

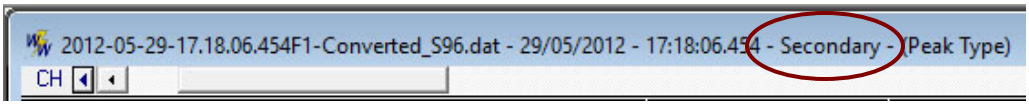


Figure 3.38 Type of Analog Values Displayed

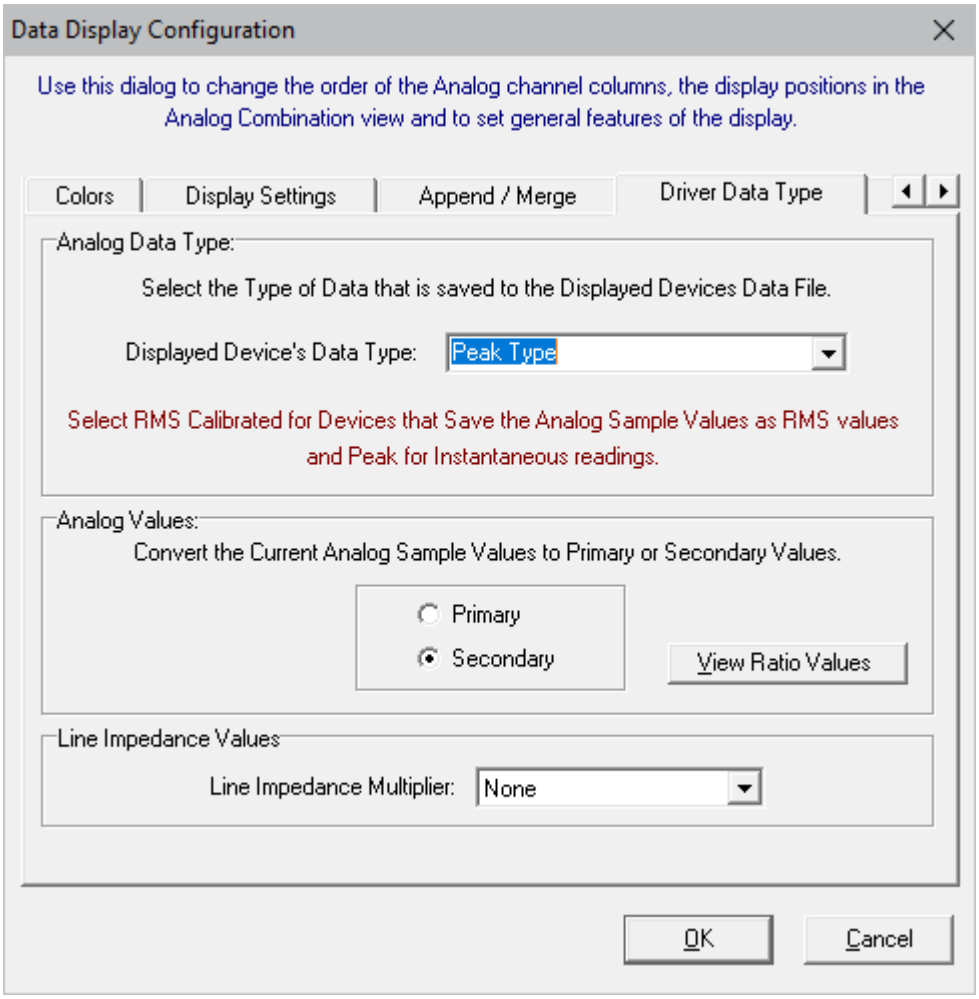


Figure 3.39 Change Analog Values (Primary ←→ Secondary)

The CT and PT ratio values can be edited by clicking on the Edit Ratio Values button in the Driver Data Type tab. The values are listed in a table format for each analog channel. The modified ratio values are not saved to the original file. To save the edited ratio values use the Save As option under the Waveform tab.

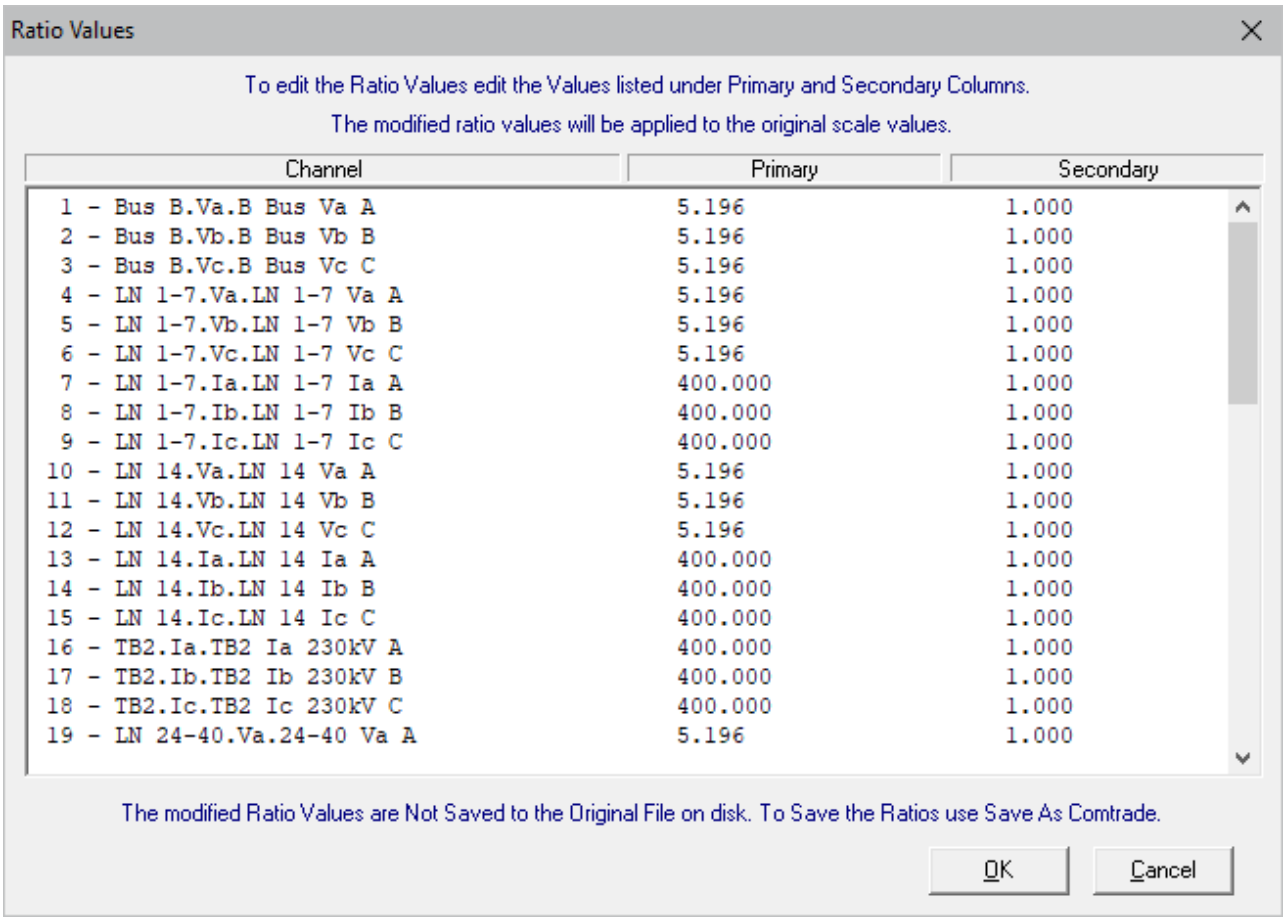


Figure 3.40 Ratio Values

ADJUST FILES DATE & TIME

The Adjust Files Date & Time allows for adjusting the date and time of the open file. To open the Adjust File Time dialog, click on the Adjust Files Time Icon under the Data tab. You can specify to add or subtract a given date or time increments from the files current date and/or time. Enter the desired time increment for the year, month, day, hour, minutes, seconds, and milliseconds. If there is no adjustment needed on a specific time field enter 0.

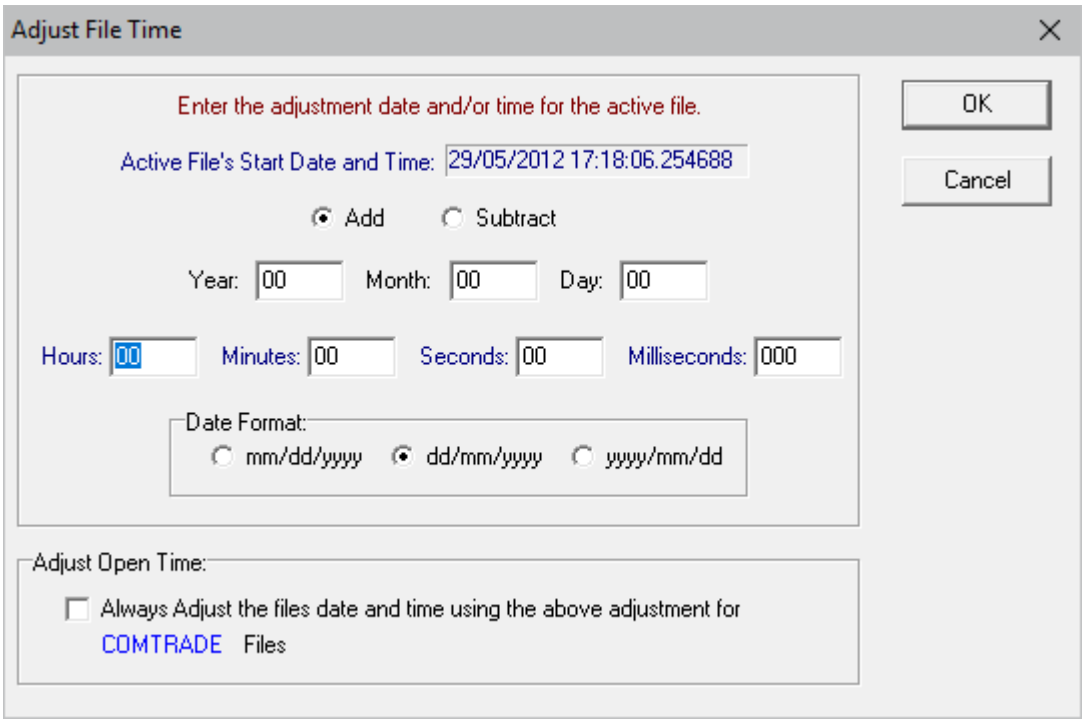


Figure 3.41 Adjust Files Date & Time

To always have the file's time automatically adjusted when a specific driver is used to open a file check the Adjust Open Time check box.

To show the file's original date and time click on the Original icon under the Data tab.

CREATING VIRTUAL CHANNELS (SACS & SDCS)

The analysis window allows for ten software analog channels (SAC) and eight software digital channels (SDC). These additional virtual channels exist only in RAM. The sample values are created using a function of the existing analog/digital channels. Predefined operators can be used to calculate a missing phase, create positive/negative and zero sequence channels; convert channels to secondary or primary values; calculate V/I for fault resistance/impedance, multiply, divide, add and subtract multiple channels; multiply, divide, add and subtract channel data by a constant value; create an envelope of an analog channel; define over-trigger or under-trigger values; calculate a missing phase; define the prefix and unit for the channel; or perform bit-wise ANDing/ORing on digital traces.

All calculations are designed to operate "on the fly". For the forward looking SAC operator ("@" some positive angle) care must be taken. Upon opening a file and while the system is reading the data samples, the forward samples are not available. In that case, the system uses the current sample instead of the requested forward sample. To execute forward looking SAC instructions, wait until the file is read and displayed, use F5 to recalculate.

SAC title and operators can be saved to an ASCII text file on disk by using the Save and Save As buttons located to the right of the SAC operators. The Open button allows for opening existing SAC files without having to manually enter the SAC titles and operators. These features are useful for reusing existing SAC operations on like files. The New button clears the existing SAC title and operators.

The SAC and SDC instructions are composed of an operator and an operand. An operand can be a channel defined by the channel number or a constant. Constant values must have a "^" operator before each value to distinguish between channel numbers and constant values. To phase shift analog channels,

use the “@” sign before each angle defined. All angles must be defined in degrees. Following is a list of all the software operators that are available:

- “**+**” - Add (Analog),
- “**-**“ - Subtract (Analog),
- “*****” - Multiply (Analog),
- “**:**” - Divide (Analog),
- “**^**” - Constant value (Analog),
- “**@**” - Phase Shift (Analog),
- “**e**” - Adjusted envelope (Analog),
- “**a**” - Envelope (Analog),
- “**<**” - Under-trigger (Analog),
- “**>**” - Over-trigger (Analog),
- **“h”** - Harmonic for Channel (Analog),
- “**h=**” - Harmonic for all Back Operations (Analog),
- "**x**" - real component (Analog),
- "**y**" -imaginary component (Analog),
- "**m**" -magnitude (Analog),
- "**d**" -angle (Analog),
- "**r**" -true RMS (Analog),
- "**f**" -cyclic frequency (Analog),
- "**q**" -instantaneous frequency (Analog),
- "**t**" -delta time frequency (Analog),
- “**s**” - sin operator (Analog),
- “**c**” - cos operator (Analog)
- "**b**" -operate between bars only (Analog),
- “|” - Absolute Value (Analog),
- “**p=**” - Prefix (Analog),
- “**u=**” - Unit (Analog),
- “**+**” - And (Digital),
- “**.**” - Or (Digital),
- “**/**” - Instruction terminator (Analog & Digital)

NOTE: All SAC/SDC operations are performed in Reverse Polish Notation (one operation at a time). The instruction set must always terminate with a “/”. An operation error is generated if the instruction formats are not followed.

Operators are formatted as a stacked set of instructions. To select from the predefined fast SACs click on the drop down list then double click on the desired SAC. The name of the SAC is in the first column and the operator is in the second column. To have the SAC name automatically copied to the SAC title click on the Set SAC Titles using Fast SAC headers check box. The position of the channel in the operators is marked by a Pound Sign #. If there are any marked channels in the data plotting window then the fast SAC will be populated with the marked channels number. For example if channels 4, 5 and 6 are marked and the Calculate Neutral fast SAC is selected then the Operator will be displayed as: +4/+5/+6/u=A/. If there are no channels marked the operator will be +#/+#/+#/u=. The user will have to replace the # with the desired channels and complete the unit.

An instruction is composed of four attributes:

1. The operator: +, -, *, :, ...

2. The operand: channel index (1, 2, 3, ...) or constant value (such as ^3.14)

3. The function: @, h, x, y, m, d, f, ...

4. Instruction terminator: /

Press F5 to display the SAC dialog or select the SACs icon under the Channels tab. To display the SDC dialog select the SDCs icon under the Channels tab. Below are some examples:

Operations	Example	Description
Addition	+7/+8/+9/	Add channels 7, 8, & 9 and store the result in the SAC.
Subtraction	+7/-8/-9/	Subtract channel 8 from channel 7 and store the result in the SAC then subtract channel 9 from the SAC and restore the values in the SAC.
+ Sequence	+1/+2@120/+3@240/:^3/p=k/u=volt/	Calculate the + sequence components and store the result in the SAC then set the SAC's prefix and unit.
- Sequence	+1/+2@240/+3@120/:^3/p=k/u=volt/	Calculate the - sequence components and store the result in the SAC then set the SAC's prefix and unit.
0 Sequence	+1/+2/+3/:^3/p=k/u=volt/	Calculate the zero sequence components and store the result in the SAC then set the SAC's prefix and unit.
Harmonics	+16/h=1/p=k/u=volt/	Extract the 1st Harmonic component from Channel 16 and store in the SAC then set the SAC's prefix and unit.
Multiplication	+3/*^2.66/	Multiply all sample values in channel 3 with the constant value 2.66 and store the result in the SAC.
Division	+7/:3/	Divide all samples values in channel 7 by the sample values in channel 3 and store the result in the SAC.
Half Cycle Envelope	+2/e/	Calculate the half cycle envelope of channel 2 and store the result in the SAC.
Envelope	+12/a/	Calculate the envelope of channel 12 and store the result in the SAC.
Under-trigger	+4/<135/	Store all the sample values from channel 4 that are < 135 in the SAC.
Over-trigger	+62/>500/	Store all the sample values from channel 62 that are > 500 in the SAC.
Absolute Value	+7/+8/+9/|/p=k/u=Volts/	Add channels 7, 8, & 9 and store the absolute value of the result in the SAC then set the SAC's prefix and unit.
Frequency	+7f/u=Hz/	Store the cyclic frequency of channel 7 and set the SAC's unit to Hertz.
Frequency	+7q/u=Hz/	Store the instantaneous frequency of channel 7 and set the SAC's unit to Hertz.
Magnitude	+11m/u=V/p=k/	Store the magnitude of channel 11, and set the SAC's unit to Volt and the prefix to k.
Real	+4x/+5x/+6x/u=V/	Store the real components of the fundamental of 4, 5 and 6 and set the SAC's unit to Volts.
Imaginary	+4/+5/+6/y2/u=V/	Store the imaginary components of 2nd harmonic of 4, 5 and 6 and set the SAC's unit to Volts.
Secondary	+1/:^3000/u=V/	Store channel 1 values divide by 3000 and set the SAC's unit to V.

Operations	Example	Description
Impedance (V/I)	+4/:6/h=1/u=mho/	Store the fundamental of channel 6 (V) divided by channel 1 (I) and set the SAC's unit to mho.
Differential Current	+1/+2/+3/+4/|/u=A/	Store the absolute value of the sum of channels 1 2 3 and 4 and set the SAC's unit to A.
Apparent Power (1=V, 4=I)	*1m/*4m/p=k/u=Watts/	Store the magnitude of channel 1 multiplied by the magnitude of channel 4 and set the SAC's prefix to k and the units to Watts.
Power Factor	+1d/-4d/c/u=Deg/	Store the cosine of the angle of channel 1 minus the angle of channel 4 then set the SAC's unit to Deg.
Active Power	+1d/-4d/c/*1m/*4m/p=k/u=Watts/	Calculate the cosine of channel 1 angles minus channel 4 angles, then store the calculated value multiplied by channel 1 magnitudes and channel 4 magnitudes, set the SAC's prefix to k and the unit to Watts.
Reactive Power	+1d/-4d/s/*1m/*4m/p=k/u=Vars/	Calculate the sine of channel 1 angles minus channel 4 angles, then store the calculated value multiplied by channel 1 magnitudes and channel 4 magnitudes, set the SAC's prefix to k and the unit to Watts.
AND	+2/.33/	AND channel 2 with channel 33 and store the result in the SAC.
OR	+2/.4/+14/	AND channel 2 with 4, then OR the result with channel 14 and store the result in the SAC.

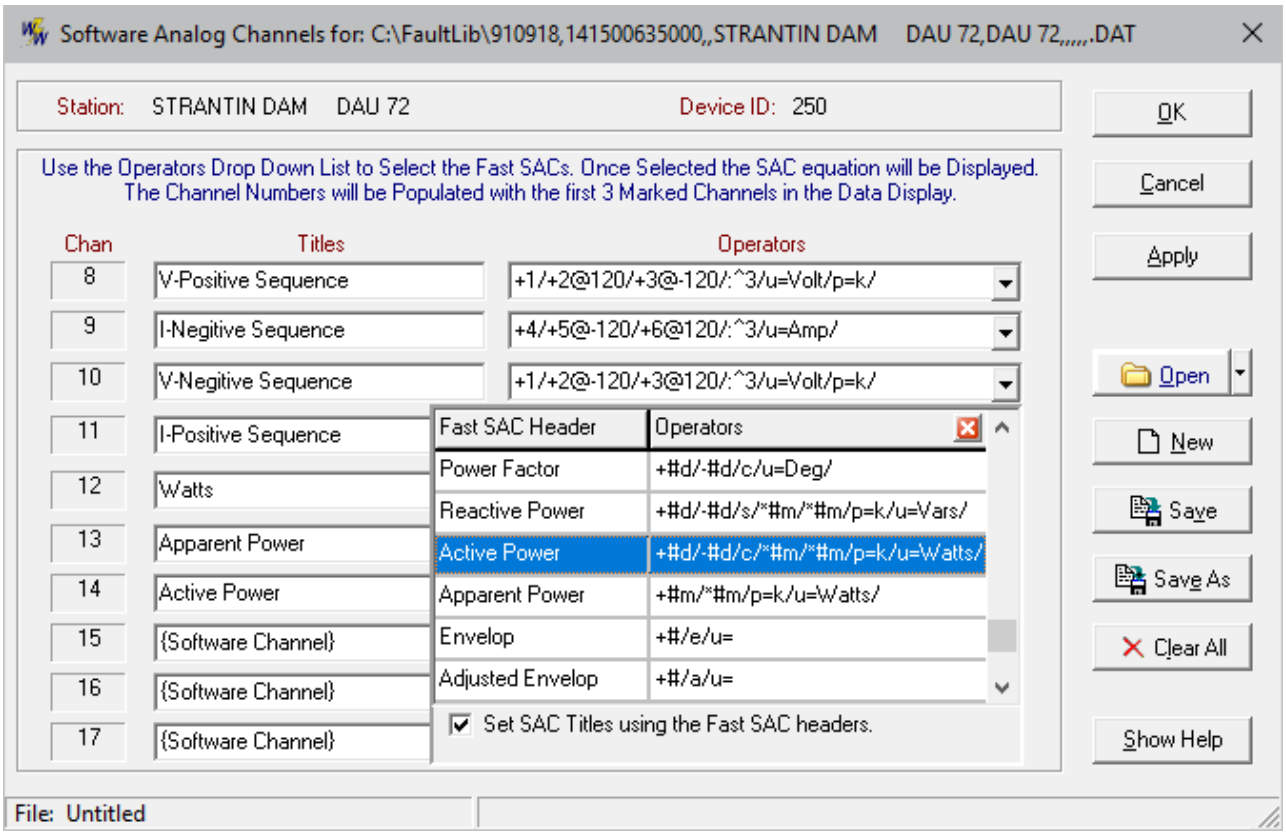


Figure 3.42 SAC Dialog

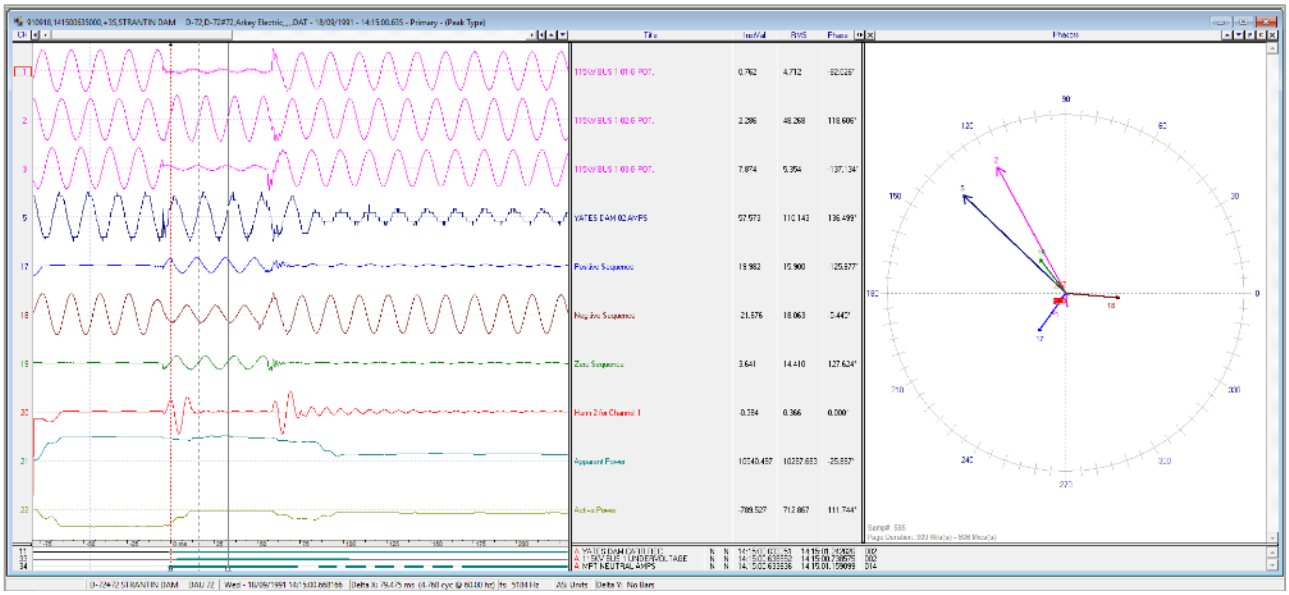


Figure 3.43 SAC Results

Engineers can use the additional channels as a generic tool for monitoring or modeling tasks. A virtual channel can be used to compute one of the phases of a monitored line by adding the remaining phases then subtracting the result from the residual channel. This in turn frees up a hardware channel for other monitoring needs.

The SAC operators and titles can be saved to an ASCII text file on disk to save time when re-entering SAC operator and titles. The SAC files can have any filename, but the extension must be .SAC. If an extension is entered when saving a SAC file then the extension is deleted and .SAC is added to the filename. The active SAC path and filename is displayed in the first status field. The second status field indicates if the SAC title or operator fields were modified.

There are 4 options for the SAC files, Open, New, Save and Save As. Each option is explained below:

SAC File Operator	Description
Open	Open an existing SAC file. The Window's open file dialog is displayed. Navigate to the desired folder and double click on the SAC file. The SAC title and operator fields are populated with the contents of the selected file. If the file is not a valid SAC file then an error message is displayed.
New	Clear the current SAC title and operators and change the SAC filename in the first status field to Untitled. If the previous SAC title and operators where modified then a message will be prompted asking to save the existing SACs before clearing the fields.
Save	Save the active SAC title and operators to the SAC file listed in the first status field. If the SAC filename is listed as Untitled then the "Save As" dialog is displayed.
Save As	Save the existing SAC title and operators to a new SAC file. The Window's "Save As" dialog is displayed. Navigate to the desired folder and enter the new name in the "File name" field and click the "Save" button or press enter.

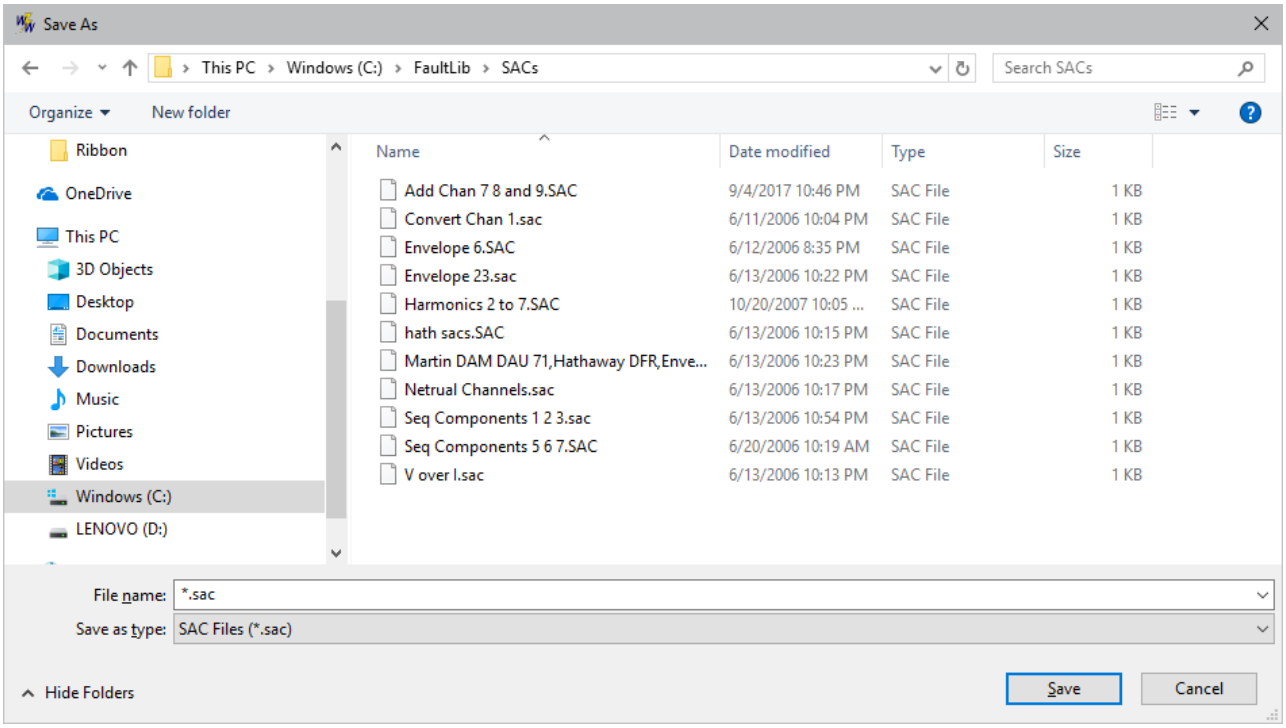


Figure 3.44 Open SAC File

PLAY CHANNELS AUDIO

It is now possible to hear the characteristics of a signal through the analysis window. To play the audio of a specific analog channel first mark the channel. Then open the Analog Channel Audio dialog by clicking on the Play Audio icon under the Data tab. The Analog Channel Audio dialog is displayed in the bottom right hand corner of the analysis window.

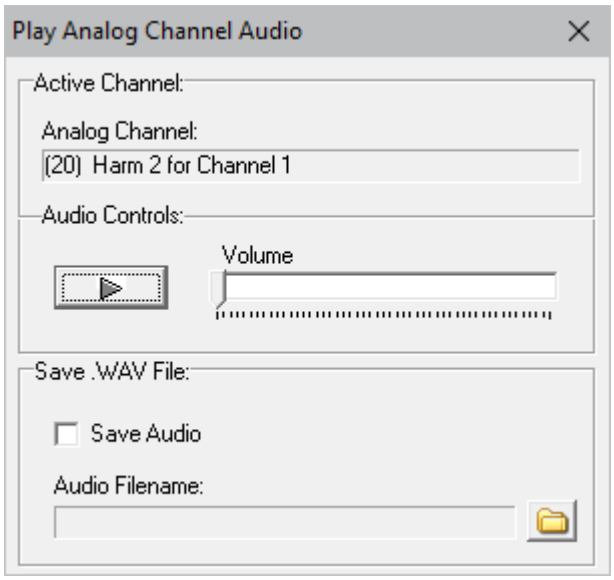


Figure 3.45 Play Audio Dialog

The Active Channel section displays the analog channel marked in the analysis window. The Audio Controls section allows for playing the active analog channel's data through the computers speakers and for increasing/decreasing the volume of the output. The Save .WAV File section allows for saving the analog channel data in the Window's .WAV format. Click the folder button to select a destination folder and to enter a new ".WAV" file or for selecting an existing ".WAV" file. The selected folder and filename will be updated in the Audio Filename field.

To view the saved ".WAV" file exit the analysis window, navigate to the ".WAV" folder and double click on the wave file. A new display driver was added to plot Microsoft's ".WAV" files.

ALIGN CHANNEL DATA

The Align Channel Data option aligns the analog channel samples according to the defined phase shift angles. The alignment routines use the Thiran 3rd Order All Pass Fractional filter. The all-pass delay guarantees no magnitude deterioration and fractional because delays can be a fraction of the sample interval.

To align the analog channels manually click on the Align icon under the Channel tab. If the Thiran filter has already been applied to the displayed analog channels a message is displayed.

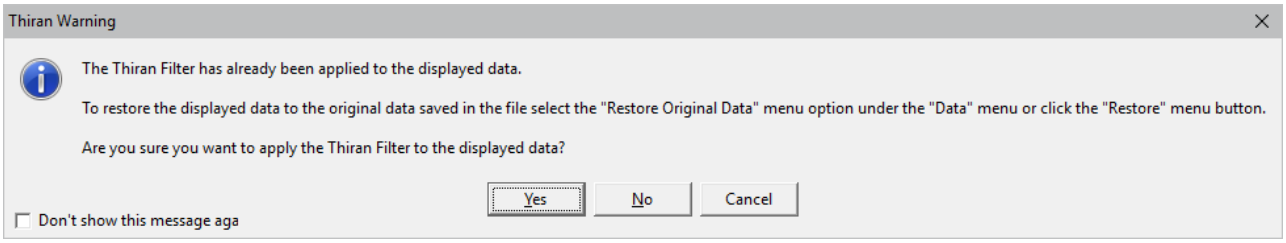


Figure 3.46 Align Channel Message

To continue to the Align Channel Data dialog click "Yes". To apply the filter to the file's original unfiltered data click "No" or "Cancel". Then select the Original icon under the Data tab.

The Align Channel Data dialog applies the Thiran filter according to the entered Phase Shift angles. Enter the phase shift angle for each analog channel. If the filter does not apply to a specific analog channel enter 0 or leave the field blank or enter NONE. To display the coefficient values used for each analog channel click the “Calculate Coefficients” button. The “A0, A1, A2 and A3” fields will be updated with the coefficients for the entered phase shift angles.

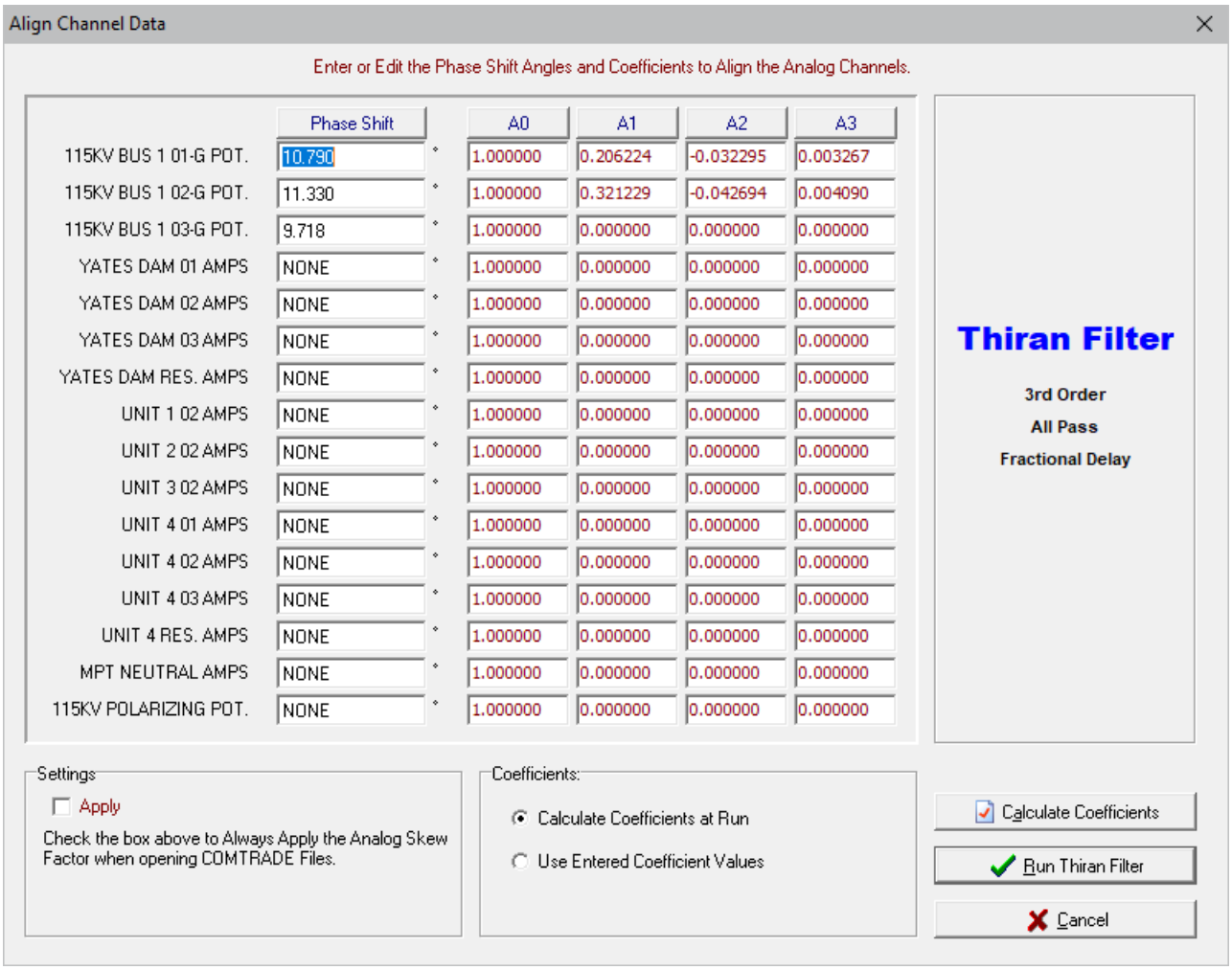


Figure 3.47 Align Channel Data Dialog

To always apply the Thiran filter on files for the active driver click the Always Apply check box. Always apply automatically runs the Thiran filter with the defined phase shift angles before displaying the file. To display the files original samples click the Original icon under the Data tab.

The coefficients used for the filter can be edited. If the coefficients are modified click the Use Entered Coefficients Values radio button. To have the coefficients automatically calculated when the filter is applied click the Calculate Coefficients at Run radio button.

USER VIEWS

User Views allow for saving and displaying specific information about a selected view. When a view is saved the following information is saved to an ASCII text file in the user defined folder.

- Displayed analog channels,
- Analog channel order,

- Superimposed channels,
- Analog channel colors,
- Digital channels displayed,
- Sampling frequency,
- Time scale,
- Sliding window size (RMS bar to Data bar),
- Phasor window size,
- Table window size,
- Red fault bar,
- Auto scale and
- Phasor or circular chart displayed

To save a view, first set up the desired view. Then click on the Save View icon under the Waveform tab. The Save View dialog is displayed.

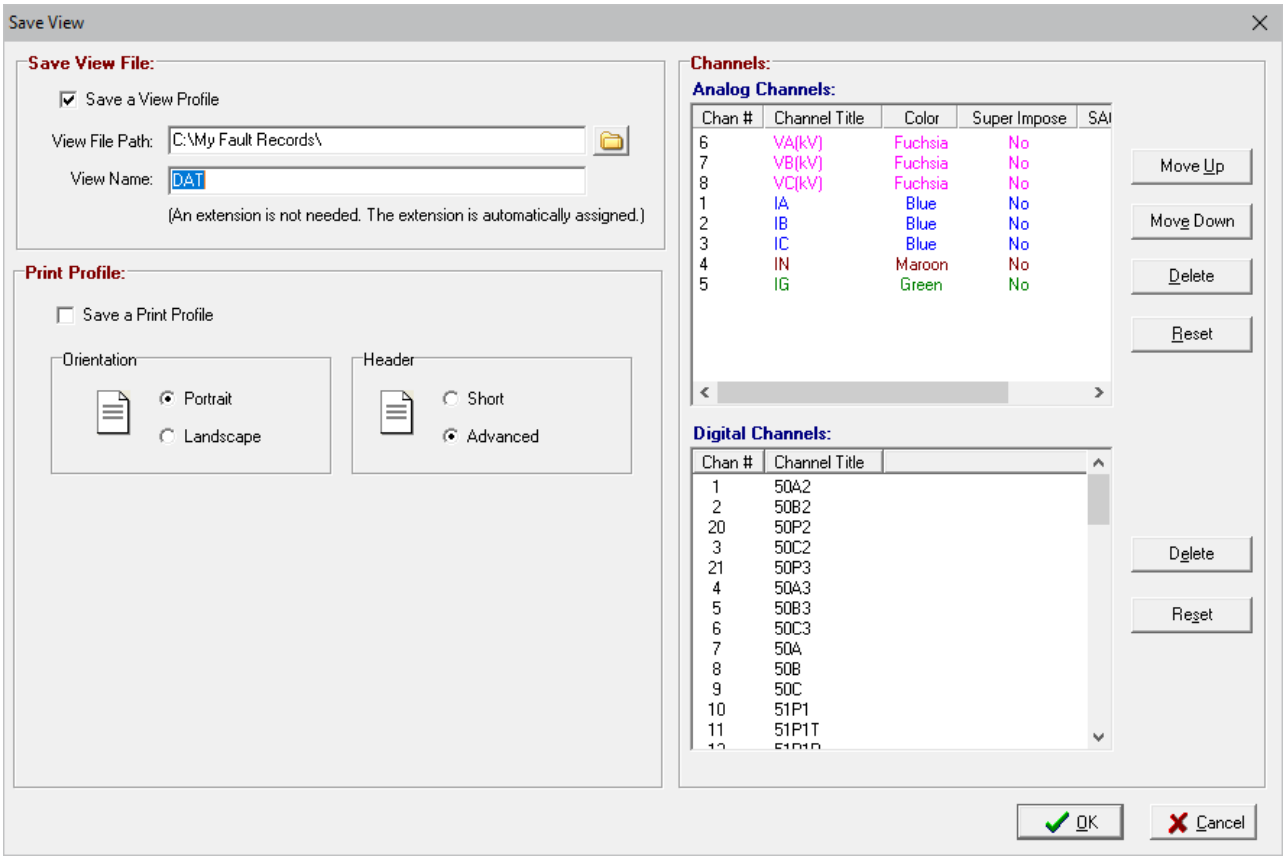


Figure 3.48 Save View Dialog

Enter the view's name in the View Name field and select or enter the destination folder into the View File Path field. By selecting the destination folder, it is possible to save a hierarchy of views that allows for easy access to specific views according to the user's preference. The channels to save can be manipulated in the Analog and Digital tables. To also save a print profile view, check the Save a Print Profile checkbox. Click the orientation type and header type. A short header will print the basic file information listed in the Waveform Summary window. The Advanced header will print the basic file information, analog and digital information from the Waveform Summary window.

To select a view open the view drop down menu. The drop down menu lists the last seven saved/selected views. If the view is not listed click on the “More View” option to open Microsoft’s select file dialog. Navigate to the view’s folder and double click on the view file.

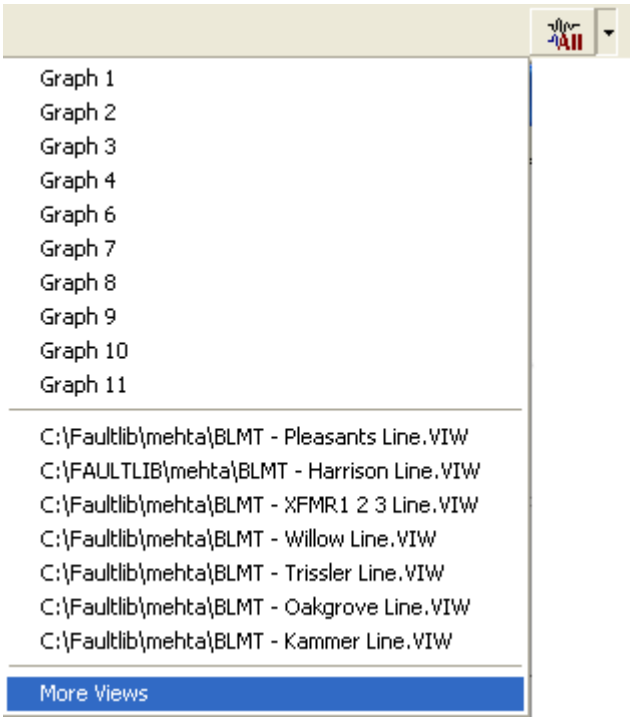


Figure 3.49 Select View Drop Down Menu

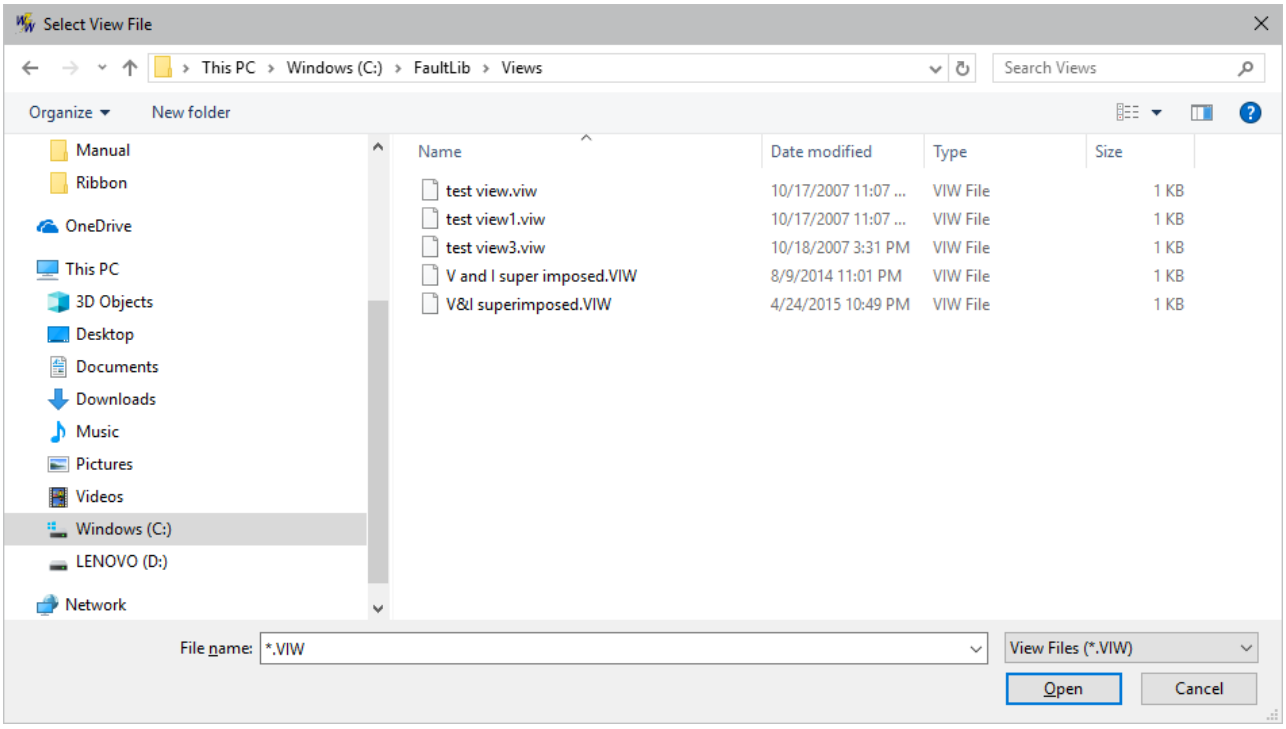


Figure 3.50 Select View File Dialog

To view the details of a saved view before selecting it, open the Select View dialog from the Waveform tab. The select view dialog has four sections. On the left side of the dialog is the list of all the available views located in the displayed view path. To change the view path either use the browse button or select a previous navigated directory from the View Path drop down list. Under the view files is the window's settings defined in the file. On the right side is the view information for each analog channel and digital channel in the view.

A number of manufactures save the lines contained in a DFR record in the header format of the file. The Transcan, Faxtrax, Director, USI and APP recorders save the line definitions in the header section of the file. These predefined lines are listed in the top section of the view drop down menu. For Transcan, Faxtrax and Director recorders the line definitions are defined in the proprietary header files. For USI and APP the line definitions are stored in the Comtrade .HDR file. The HDR files are located in the manufactures install path. To define the location of the USI and APP line definition files open the Drive Configuration dialog. Refer to the Device Configuration section in the File Manager Quick Start. Select the USI Comtrade Files or the APP Comtrade Files under the Drivers list box. On the right hand side enter the path for the line definition files in the Driver's Line Directory field.

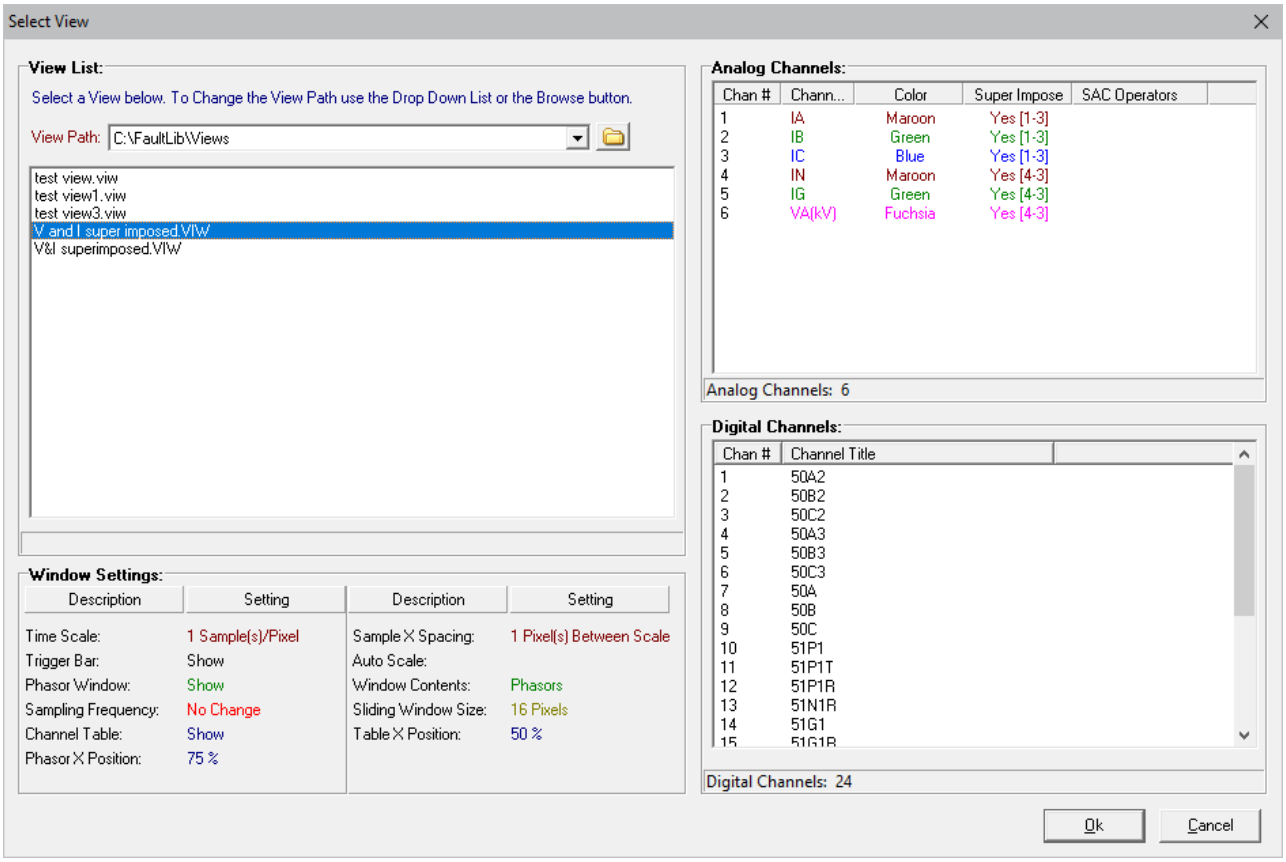


Figure 3.51 Select View Details Dialog

Double click on the view file or select the file and click "OK". If the analog channel and digital channel names defined in the view file are not in the displayed file then an error message is displayed. To exit the dialog without selecting a view, click on the Cancel button.

SINGLE ENDED FAULT LOCATION CALCULATOR

The single ended fault location calculator calculates a single ended Fault Location. The single ended calculator has four types of calculators: Radial Line Method, Reactance Method, Multi-Phase and Three Phase.

To open the single ended fault location calculator, select the Single Ended Icon under the Data tab. To convert the line Z1 and Z0 fields from primary to secondary and vice versa click on the arrow next to the Positive Sequence definition and select the multiplier from the drop down list for the Line Impedance Multiplier field.

The single ended calculator is a stay on top window which allows for changing the position of the data bar while the dialog is open. When using the cursor keys to move the data bar make sure the data window is the active window.

Radial Line Method:

To calculate the radial line method click on the Radial Line Method tab. Select the faulted voltage channel from the V Channel Number drop down list and select the faulted current channel from the I Channel Number drop down list. Next, enter the Z1 and Z0 magnitude and angle. If the Z1 and Z0 values are stored in the opened file then these fields will be automatically populated.

The magnitude and angle for Vf and If are read from the data bar position in the selected open window. To change the position of the data bar, click on the desired location in the waveform window. The data values will be automatically populated, and the fault location is updated. To update the fault location click on the Calculate button.

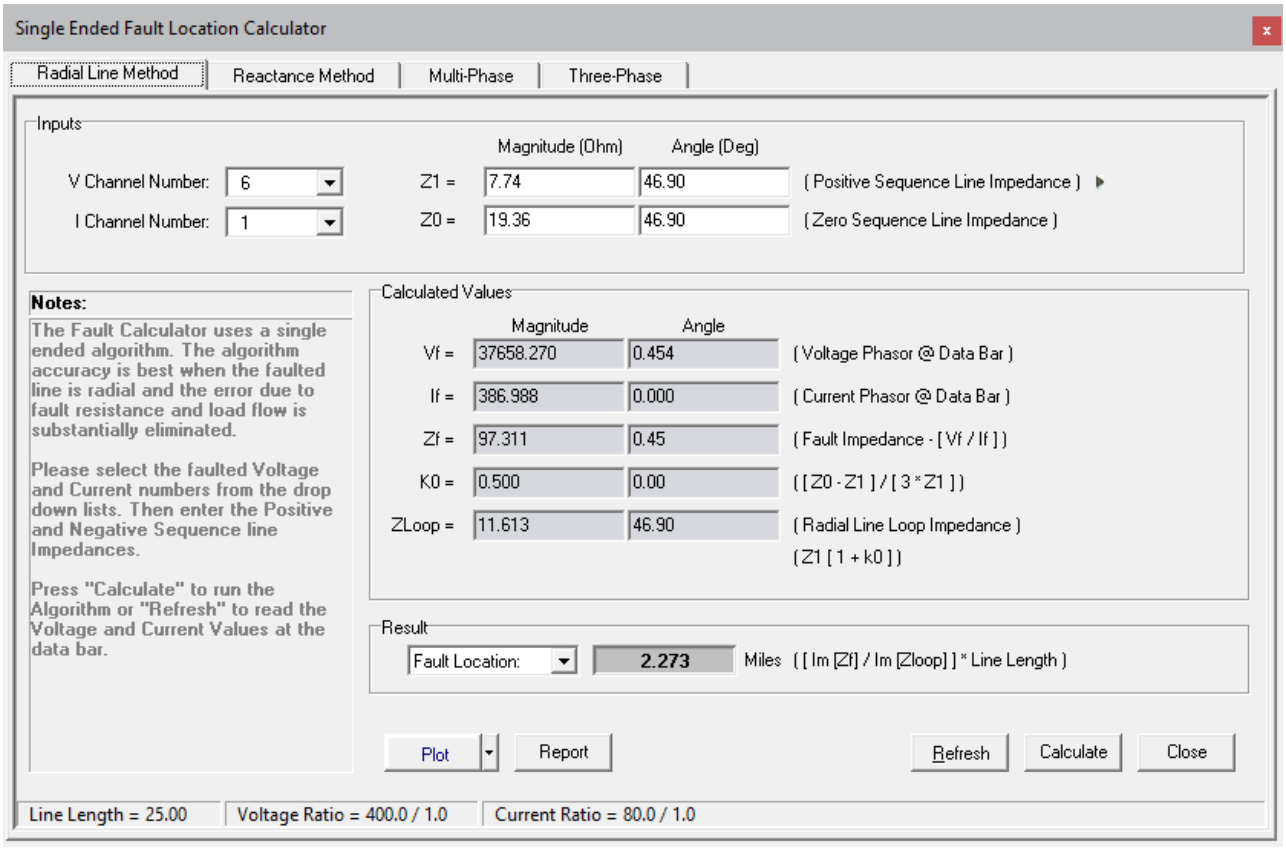


Figure 3.52 Single Ended Fault Calculator: Radial Line Method

Reactance Method:

To calculate the reactance method click on the Reactance Method tab. Select the Voltage fault channel from the V Channel Number drop down list, select the faulted current channel from the I Channel Number drop down list and select the neutral channel from the N Channel Number drop down list. Next, enter the

Z1 and Z0 magnitude and angle. If the Z1 and Z0 values are stored in the opened file header then these fields will be automatically populated.

The magnitude and angle for Vf, If and IN are read from the data bar position in the selected open window. To change the position of the data bar, click on the desired location in the waveform window. The data values will be automatically populated, and the fault location is updated. To update the fault location click on the Calculate button.

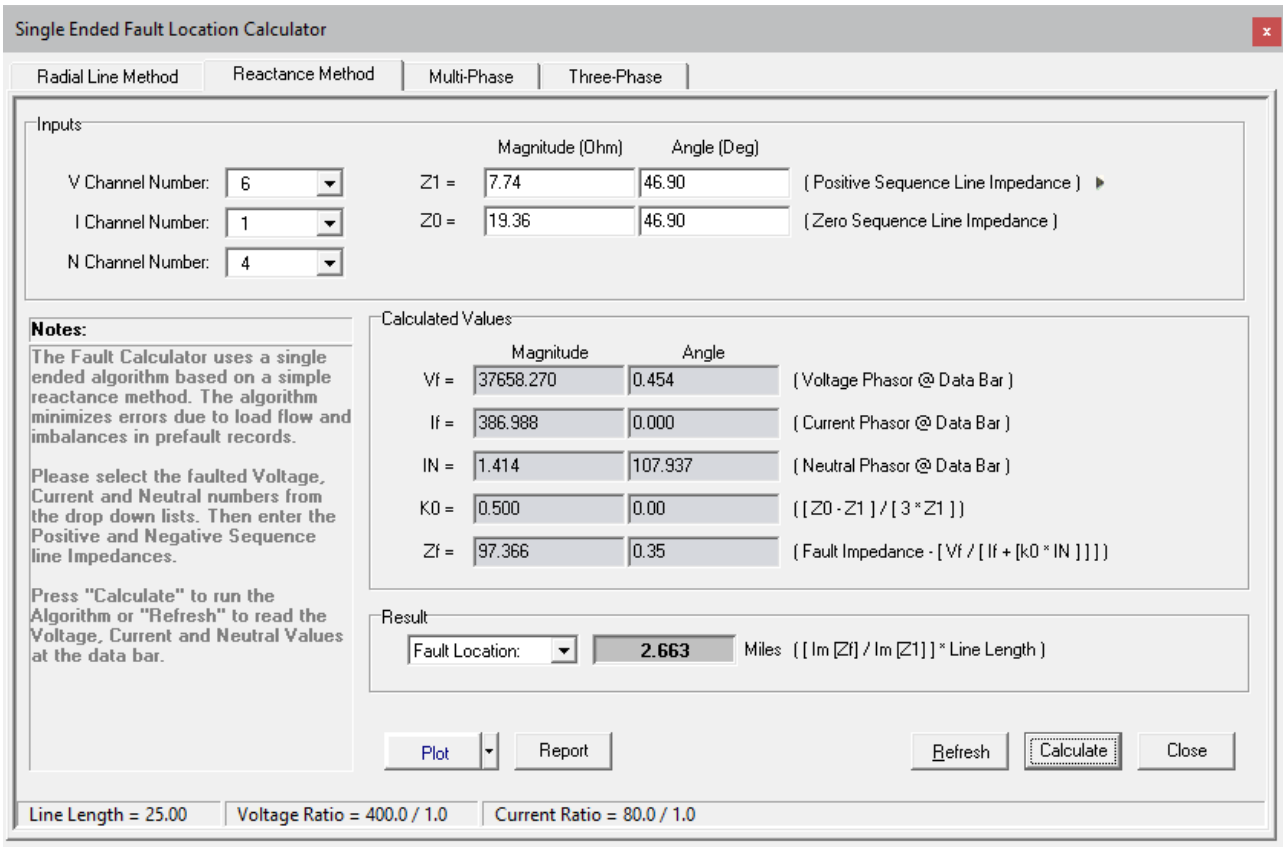


Figure 3.53 Single Ended Fault Calculator: Reactance Method

Multi-Phase Method:

To calculate the multi-phase method click on the “Multi-Phase” tab. Select the two faulted voltage channels from the Vf1 Channel Number and Vf2 Channel Number drop down lists, select the two faulted current channels from the If1 Channel Number and If2 Channel Number drop down lists. Next, enter the Z1 and Z0 magnitude and angle. If the Z1 and Z0 values are stored in the opened file header then these fields will be automatically populated.

The magnitude and angle for Vf1, Vf2, If1 and If2 are read from the data bar position in the selected open window. To change the position of the data bar, click on the desired location in the waveform window. The data values will be automatically populated, and the fault location is updated. To update the fault location click on the Calculate button.

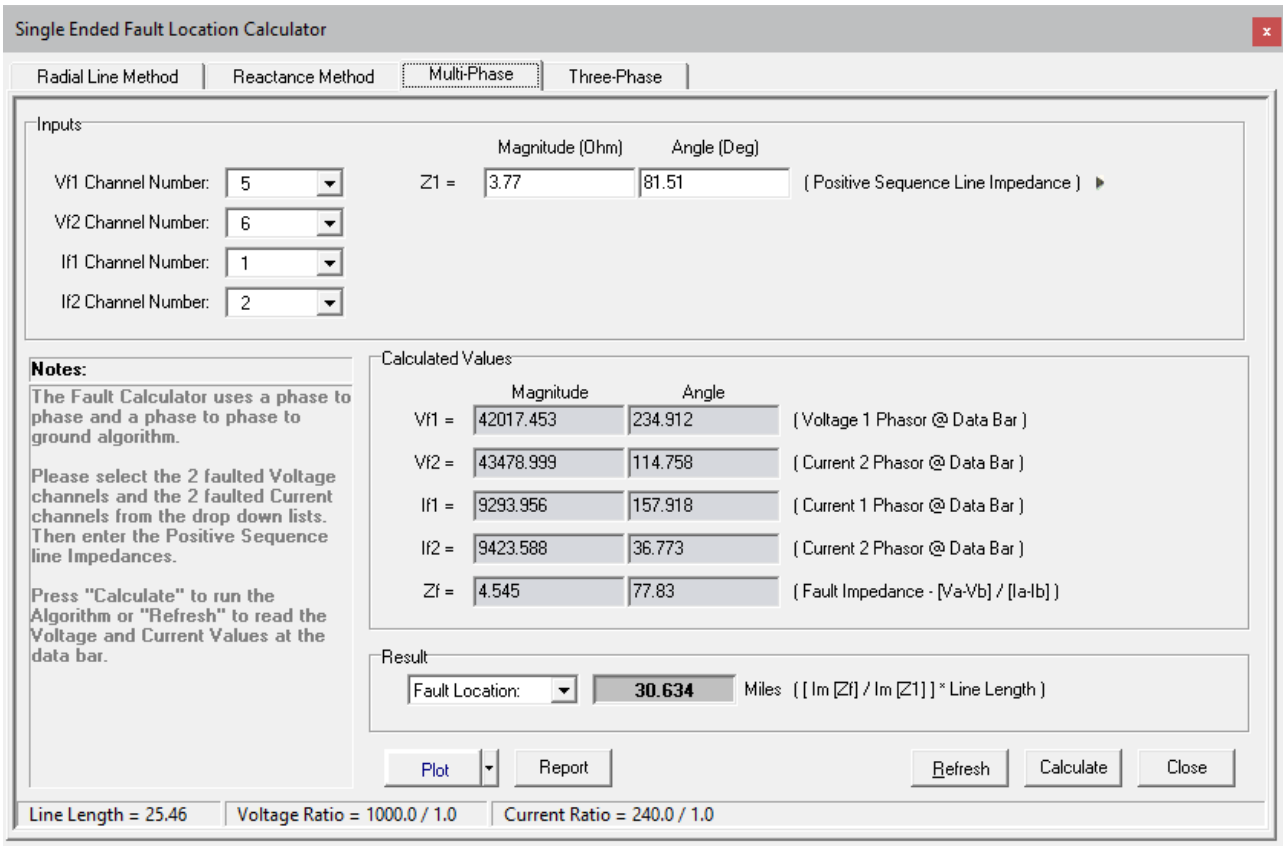


Figure 3.54 Single Ended Fault Calculator: Multi-Phase Method

Three-Phase Method:

To calculate the three-phase method click on the Three-Phase tab. Select the three faulted voltage channels from the VA, VB and VC drop down lists, select the three faulted current channels from the IA, IB and IC drop down lists. Next, enter the Z1 and Z0 magnitude and angle. If the Z1 and Z0 values are stored in the opened file header then these fields will be automatically populated.

The magnitude and angle for VA, VB, VC, IA, IB and IC are read from the data bar position in the selected open window. To change the position of the data bar, click on the desired location in the waveform window. The data values will be automatically populated, and the fault location is updated. To update the fault location click on the Calculate button.

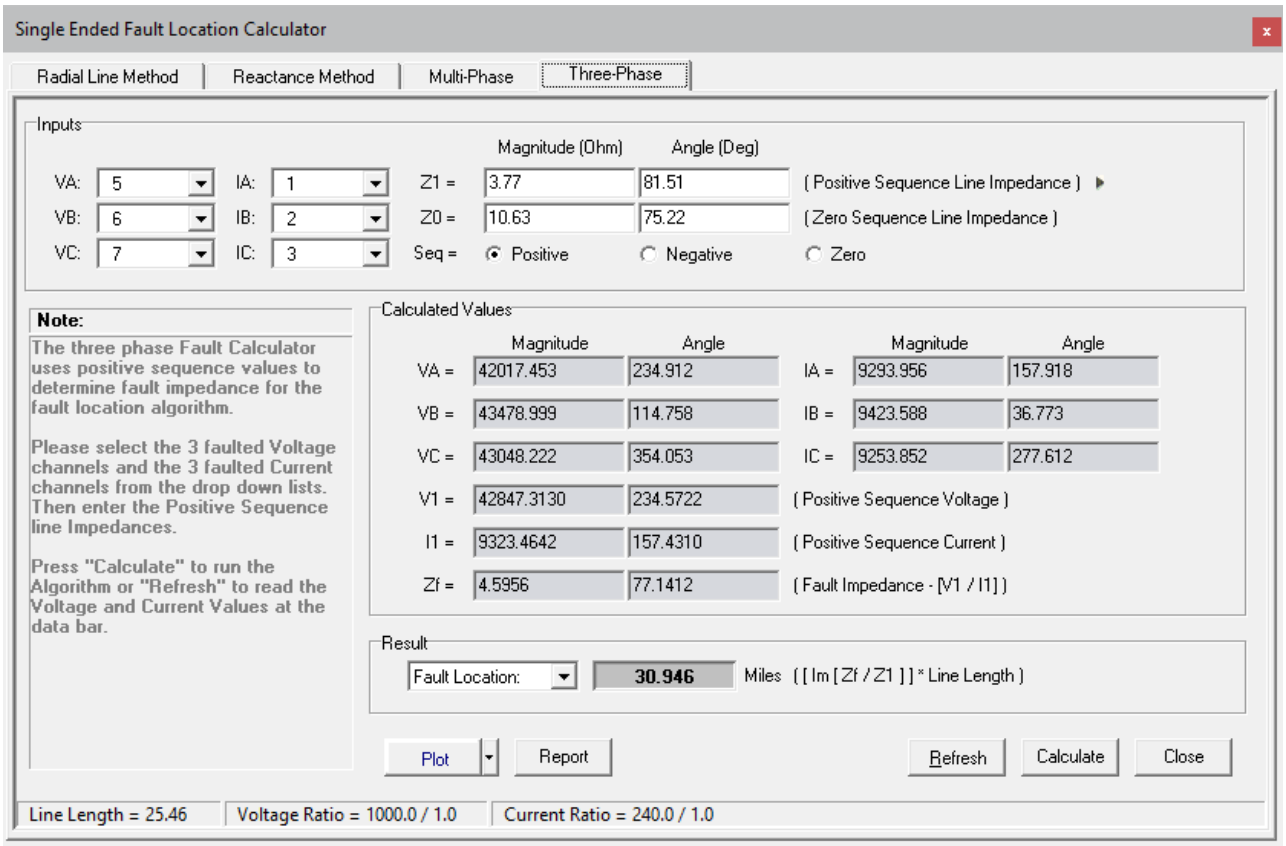


Figure 3.55 Single Ended Fault Calculator: Three-Phase Method

Plot the Single Ended Fault Location:

To plot the fault location in the data plotting window as a new channel, click on the drop down arrow in the plot button. The two options are plot the fault location between bars or plot the fault location for the entire record. The default option of the plot button is plot between bars. Between bars plots the fault location between the data bar and the reference bar.

Figure 3.56 Single Ended Plot Button

Before plotting the fault location between bars make sure the data and reference bar are positioned on the proper samples in the data plotting window.

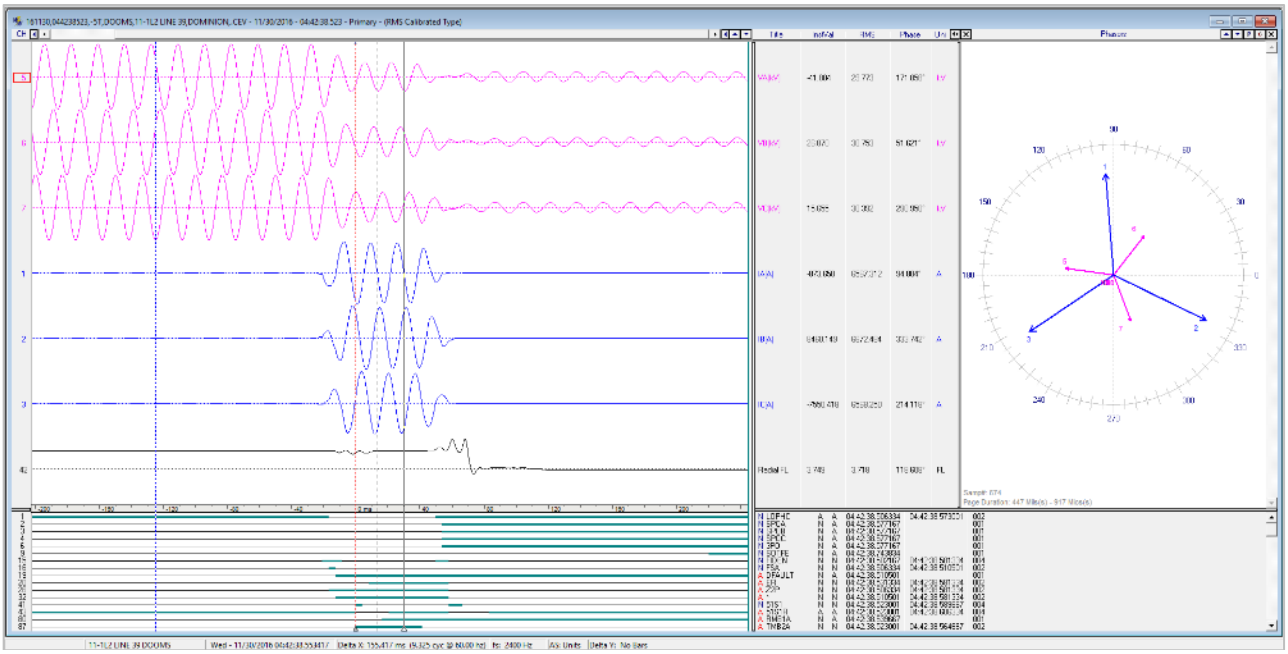


Figure 3.57 Single Ended Plot Radial: Channel 18

DOUBLE ENDED FAULT LOCATION CALCULATOR

The double ended fault location calculator calculates a double ended Fault Location using the two open fault records (near and far ends). The near end is the top left window displayed. To reorganize the windows use the Tile buttons  . To open the double ended fault location dialog click on the Double Ended FL Icon under the Data tab.

The double ended fault location dialog is first displayed in the summary mode. The summary mode has the basic input fields (ZL and line length) along with the fault location results. To expand the window to show the details of the fault location click on the Show Details button.

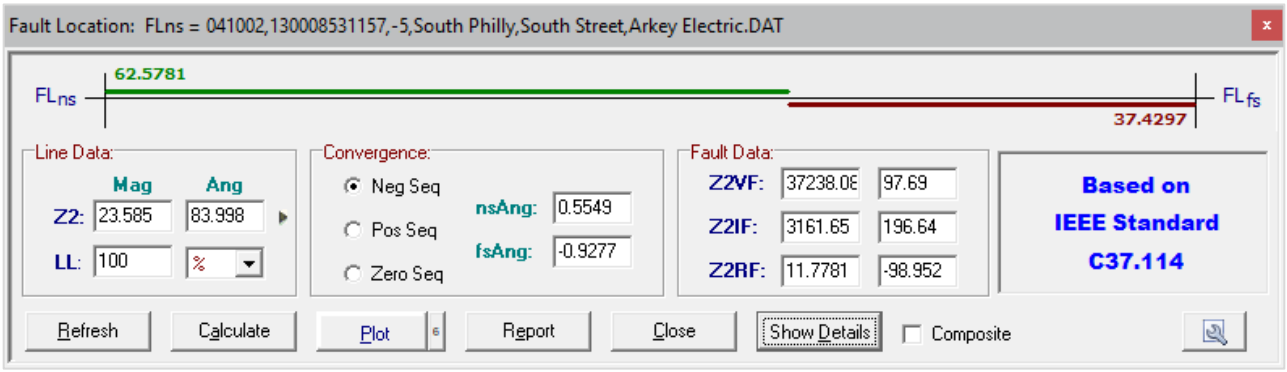


Figure 3.58 Double Ended Fault Calculator: Summary Window

If the fault location is based on the summary window then the channels in each record must be organized as follows: the first 3 visible channels are the voltage channels, VA, VB and VC. The next 3 visible channels are the current channels, IA, IB and IC. To reposition the analog channels first mark the channels then use the plus key to move the channels up one position and the minus key to move the channels down one position or drag the channels to the proper positions. If the channels are not organized as listed then click the Show Details button and change the channel numbers using the drop down list to the left of the channel labels.

The values populated in the dialog are read at the data bar positions from both open records. The double ended dialog is a stay on top window. This allows for repositioning the data bars without closing the dialog. To refresh the Voltage and Current values in the dialog use the Refresh button.

To increment the voltage and current angles for the near end and far end enter an increment value in the angle rotation fields and click on the Rotate button. This allows for a more accurate fault location when the results angle is closest to zero.

Use the Calculate button to calculate the double ended fault location.

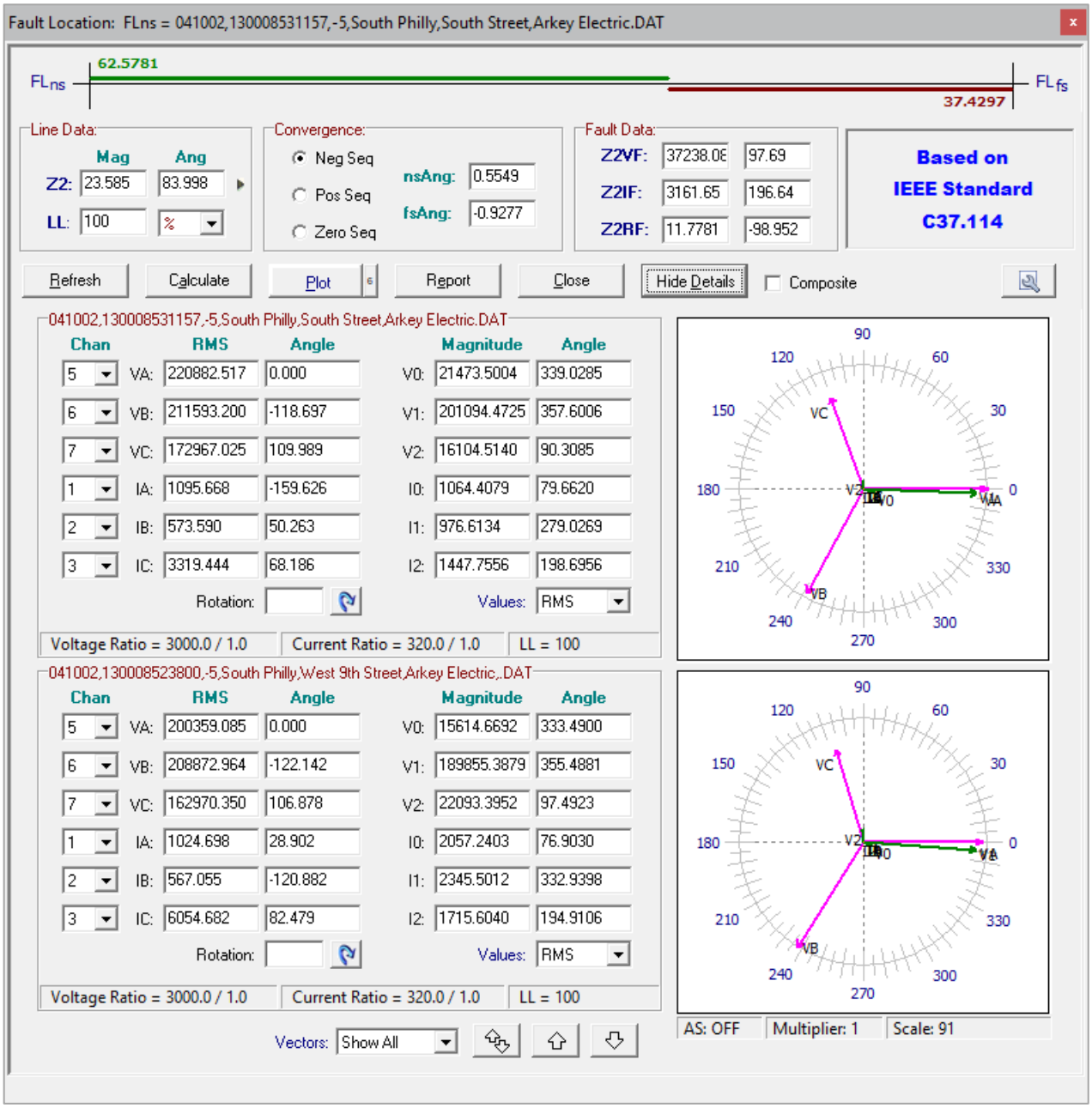


Figure 3.59 Double Ended Fault Calculator: Details

Plot the Double Ended Fault Location:

To plot the fault location in the data plotting window as a new channel, click on the drop down arrow in the plot button. The two options are plot the fault location between bars or plot the fault location for the entire record. The default option of the plot button is plot between bars. Between bars plots the fault location between the data bar and the reference bar.

Figure 3.60 Double Ended Plot Button

Before plotting the fault location between bars make sure the data and reference bar are positioned on the proper samples in the data plotting window.

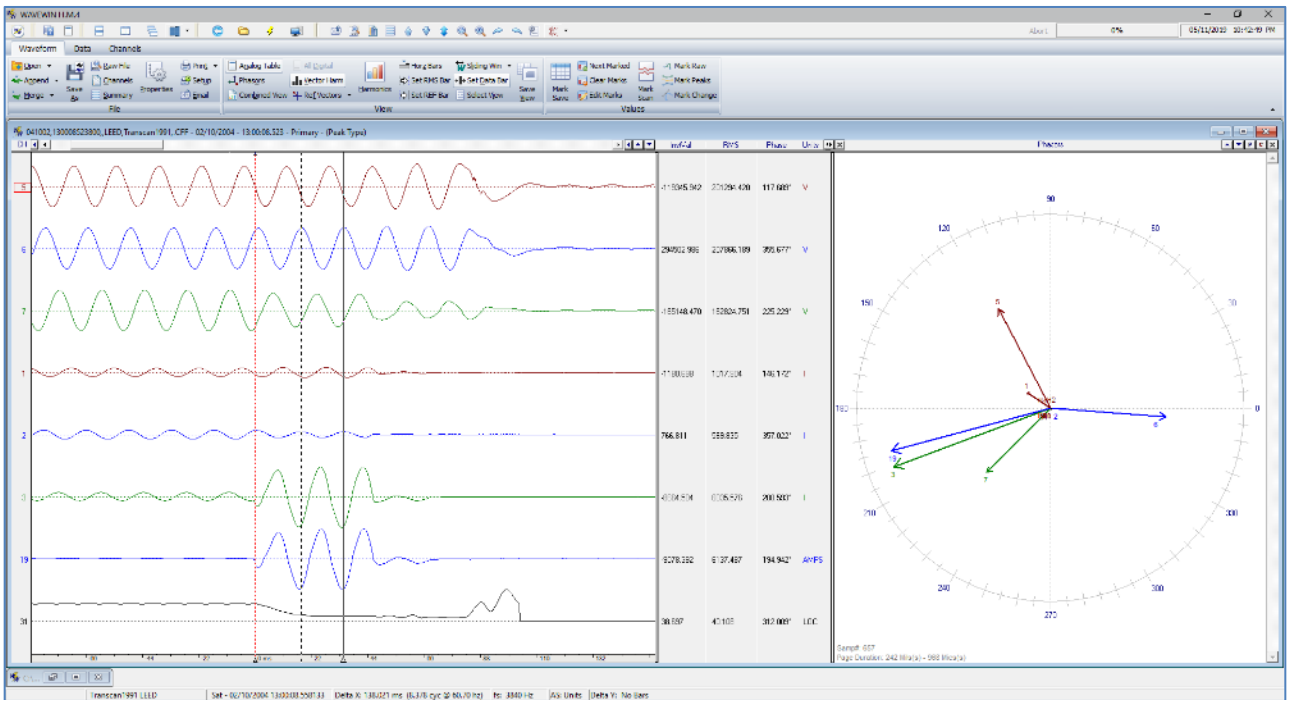
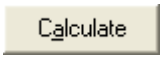
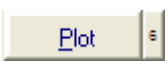
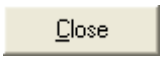


Figure 3.61 Double Ended Plot: Channel 19

The action for each button in the double ended fault location dialog is listed below:

Button	Image	Description
ZL Settings		The ZL settings button displays the ZL settings for the two open records. A red ! symbol is displayed next to the button if the ZL settings do not match.
Refresh		Refresh the data values from both open records and calculate the fault location.
Calculate		Calculate the double ended for the data values at the cursor position.
Plot		Plot the double ended fault location for the top displayed record (near end). Plot between bars or for the entire record.

Report		Opens an edit window with a textual report of the double ended fault location information. See the Double Ended Fault Location Report for more information.
Close		Close the double ended fault location window.
Show/Hide Details		Show/Hide the details section of the double ended fault location window.
Composite		Doubles the Line Data magnitude.
Rotate		Rotate the Angles to get as close to zero as possible.
Auto Scale		Turn Auto Scale On/Off for the Phasors diagram.
Up Arrow		Increase the Phasors by a multiplier of 2.
Down Arrow		Decrease the Phasors by dividing by 2.

Double Ended Fault Location Report:

The Report button will display a textual report with all the information contained in the doubled ended fault location dialog. The report is editable and can be saved under a new name using the Save As button located to the right of the File name field.

The report contains six sections:

- Double Ended Fault Location: This section list the fault location in percent of line length for both ends of the line.
- Line Impedance Data: This section lists the Line Impedance magnitude and angle.
- Convergence Data: This section lists the method used for the fault location : negative, positive or zero sequence, near side angle and far side angle.
- Fault Resistance Data: This section lists the magnitude and angle of the Voltage zero sequence, Current of the near end plus the current of the far end and voltage divided by the current.
- Near Side File Information: General Information about the near side file.
- Far Side File Information: General Information about the far side file.

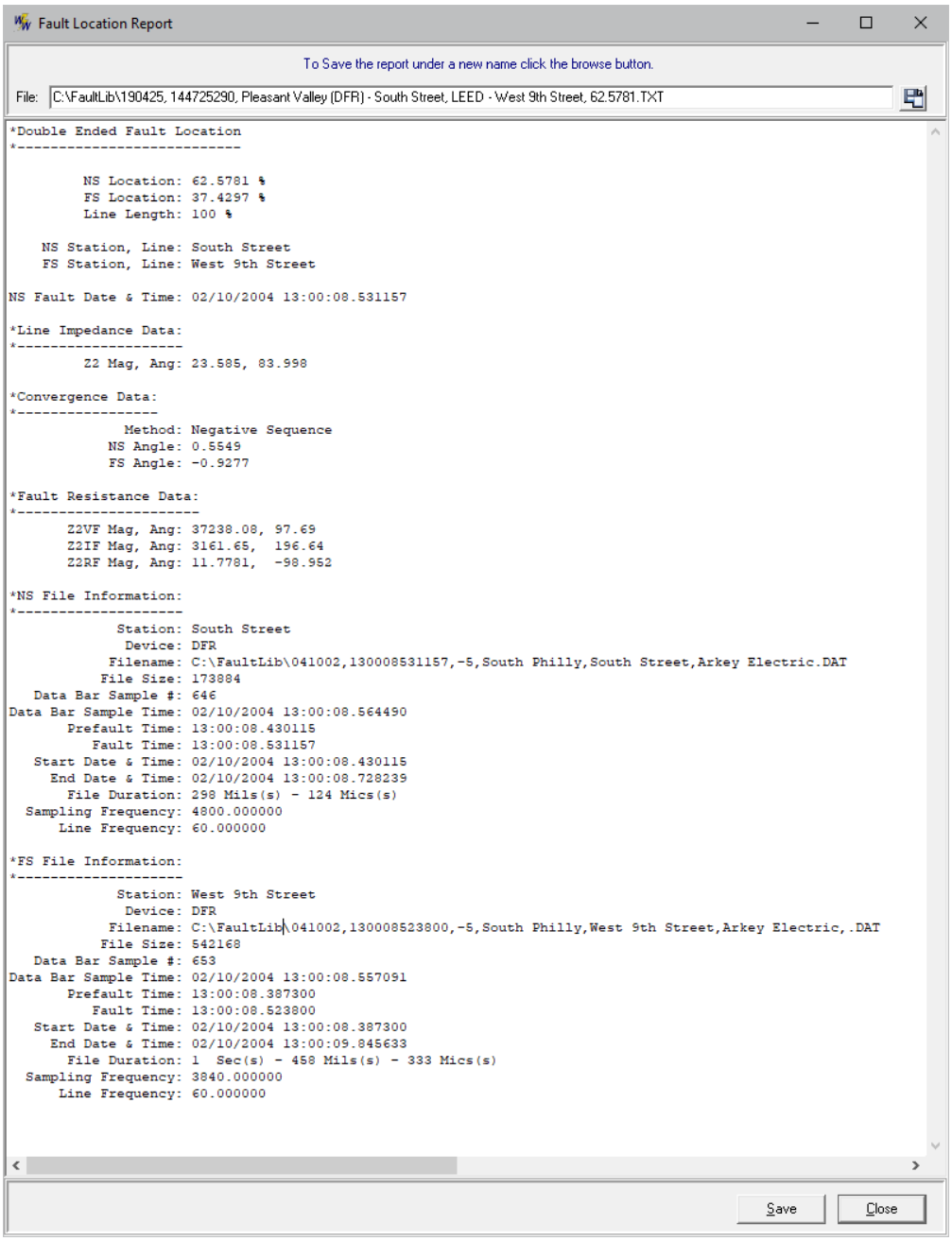


Figure 3.62 Double Ended Fault Location: Report

SEQUENCE COMPONENTS CALCULATOR

The sequence components calculator calculates the zero, positive and negative sequence components for the data values at the data bar for the active window (single) or for two open windows (end to end).

The channels in the active records must be organized as follows: The first 3 visible channels are the voltage channels, VA, VB and VC. The next 3 visible channels are the current channels, IA, IB and IC. To reposition the analog channels first mark the channels then use the plus key to move the channels up one position and the minus key to move the channels down one position or drag the marked channels to the proper position. If the channels are not organized as suggested then the channel numbers can be changed directly in the dialog using the drop down lists to the left of the channel labels.

The values populated in the dialog are read at the data bar positions in the open records. The sequence calculator dialog is a stay on top window. This allows for repositioning the data bars without closing the dialog. To refresh the voltage and current values in the dialog use the Refresh button.

Use the Calculate button to calculate the sequence components. To increment the voltage and current angles enter an increment value in the Angle Rotation field and click on the Rotate button.

To open the sequence calculator dialog select the Sequence Calculator Icons under the Data tab.

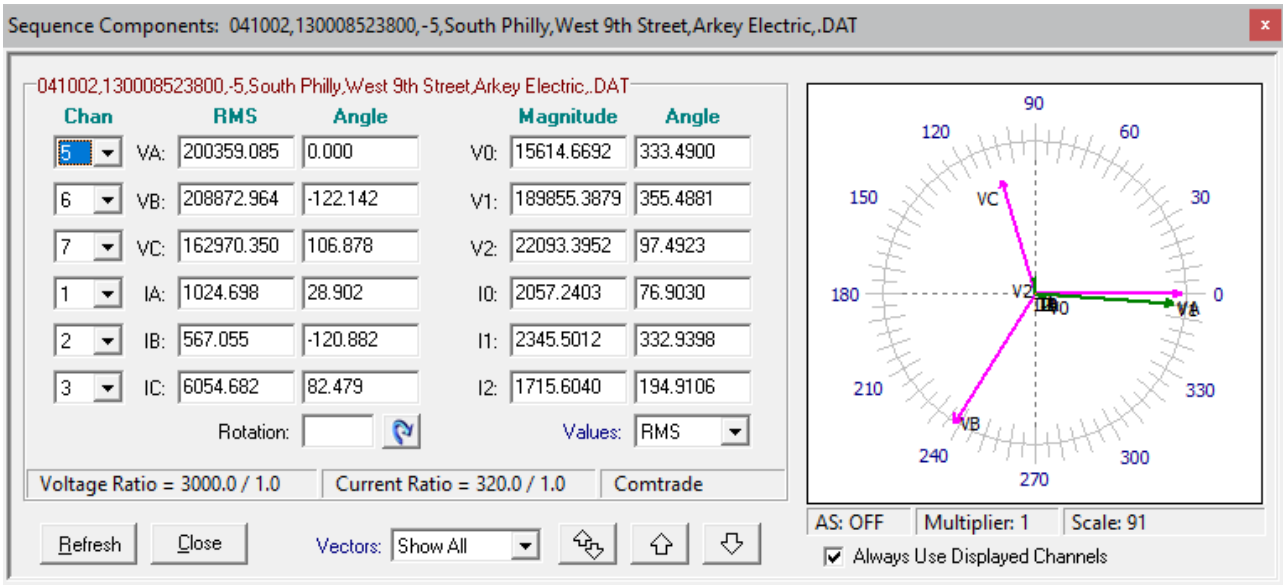


Figure 3.63 Sequence Components Calculator Dialog – Single End

To always use the displayed channels that are selected in the voltage and current drop down lists when opening the Sequence Components Calculator use the checkbox, “Always Use Displayed Channels”. This will always preselect the analog channels when opening the sequence components calculator if they exists in the file.

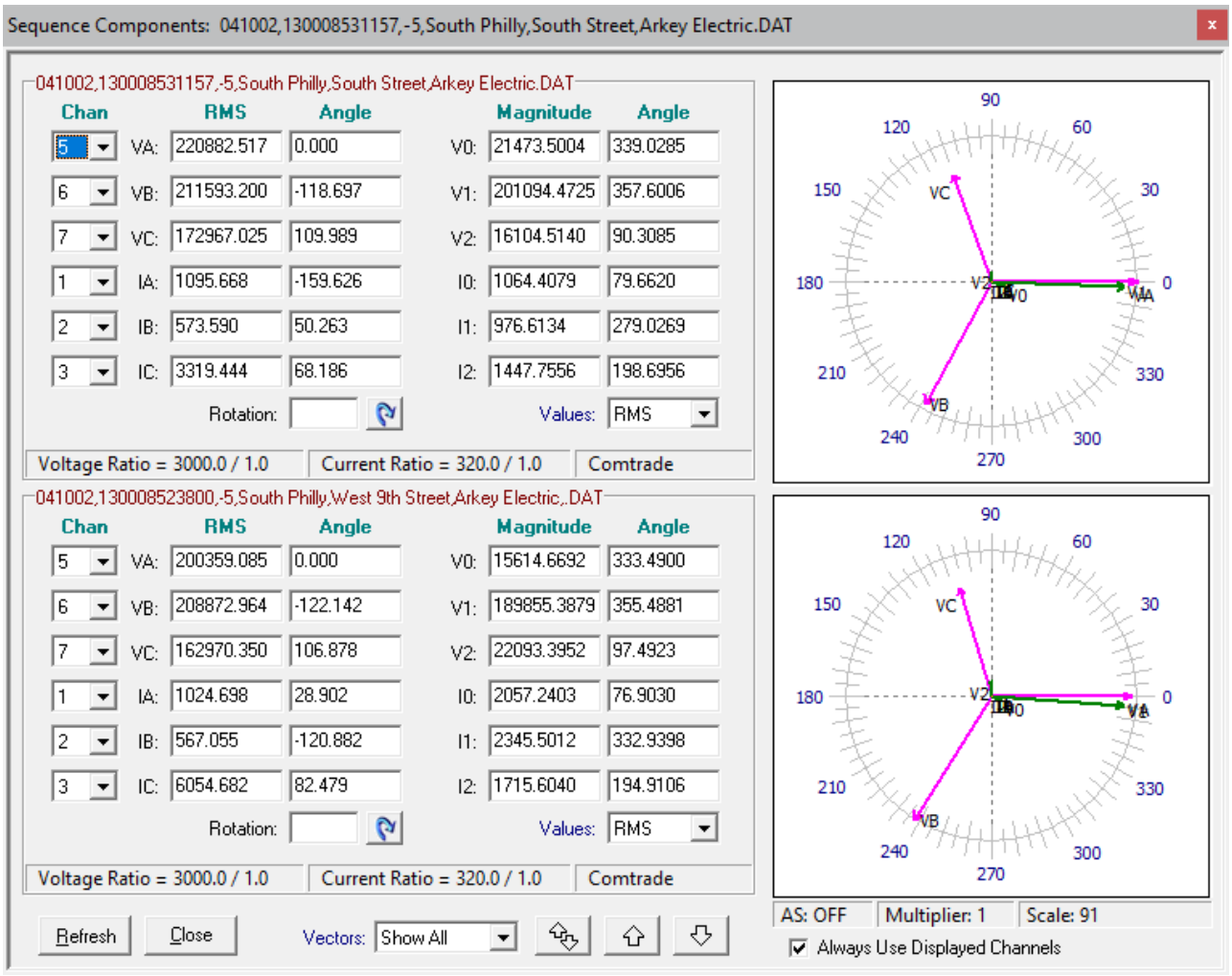


Figure 3.64 Sequence Components Calculator Dialog – End to End

SAVE AS: CSV FORMAT

The save as CSV format allows for saving specific analog information into a CSV comma delimited format. There are four options under the Save As Comtrade dialog Save As Type drop down list: RMS Values, Instantaneous Values, Vector Values (Magnitude and Angle) or Vector Values (RMS and Angle).

The first line in the CSV file is the header information for each channel. All the analog channels displayed in the active data plotting window are saved.

A dialog box is displayed to enter the destination path and the filename. The destination path is automatically defaulted to the active path in the file manager. The filename can be directly entered into the File Name field, or the file can be automatically named using the IEEE C37.232 long file naming format. To have the file automatically named click on the ComNames check box. If the ComNames check box is checked then the File Name field will be disabled. To enter a file name make sure the ComNames check box is unchecked.

The four Save As CSV options are:

- Save As CSV - RMS Values: Save the RMS Values in a comma delimited format.
- Save As CSV - Instantaneous Values: Save the Instantaneous Values in a comma delimited format.

- Save As CSV - Vector Values (Mag & Angle): Save the DFT Magnitude and Angle in a comma delimited format.
- Save As CSV - Vector Values (RMS & Angle): Save the RMS Value and Angle in a comma delimited format.

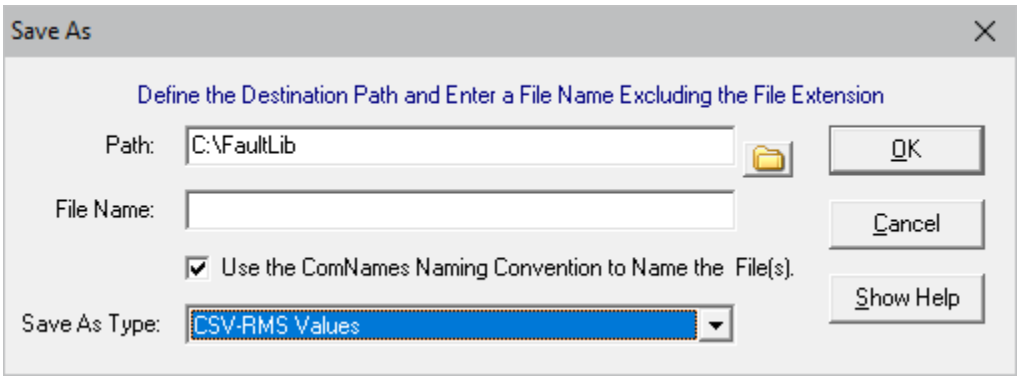


Figure 3.65 Save As: CSV Format Dialog

The Save As CSV dialog fields are described below:

- **Path:** The path field is automatically defaulted to the active path in the Wavewin file manager. To change the "Path", enter a new path in the edit box or click on the browse button to select an existing path.

- **File Name:** Enter the file name in the edit box. The file name edit box is only active for input if the Use the ComNames Standard to Name the file check box is unchecked. To save the file using the IEEE C37.232 long file naming format click on the Use the ComNames Standard to Name the file check box.

- **Use the ComNames Standard to Name the File**: The Use the ComNames Standard to Name the file check box will automatically assign the file name using the IEEE C37.232 long file naming format. If the check box is checked then the file name field is disabled.

The file format saved is a comma delimited text file and the .CSV extension is automatically assigned. The first line in the file defines the header information. The first two columns are the samples date and time. Below is an example of the header:

DATE(0/DATE),TIME(1/TIME),IA(4/Amps),IB(4/Amps),IC(4/Amps),VA(4/Volts),VB(4/Volts),VC(4/Volts)

All files saved using the Save As CSV format are recognized as plotting files using the SDC display driver. Wavewin will automatically recognize the saved format and display it in the data plotting window.
Below are screen dumps of some of the Save As CSV options.

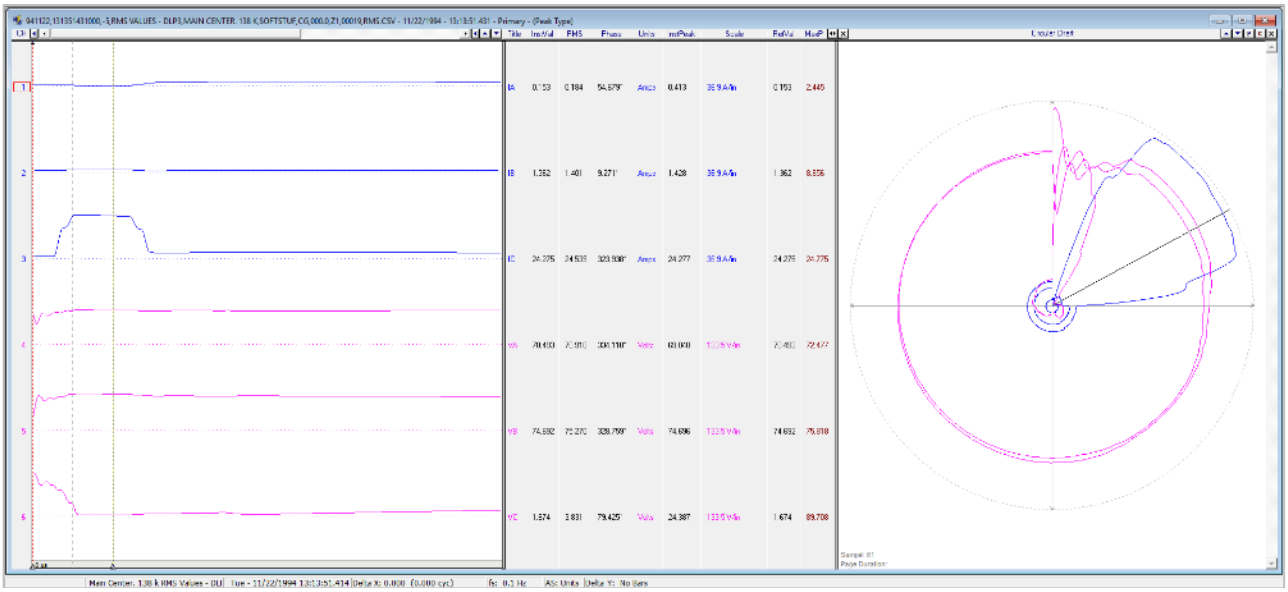


Figure 3.66 Save As: CSV Format - RMS Display

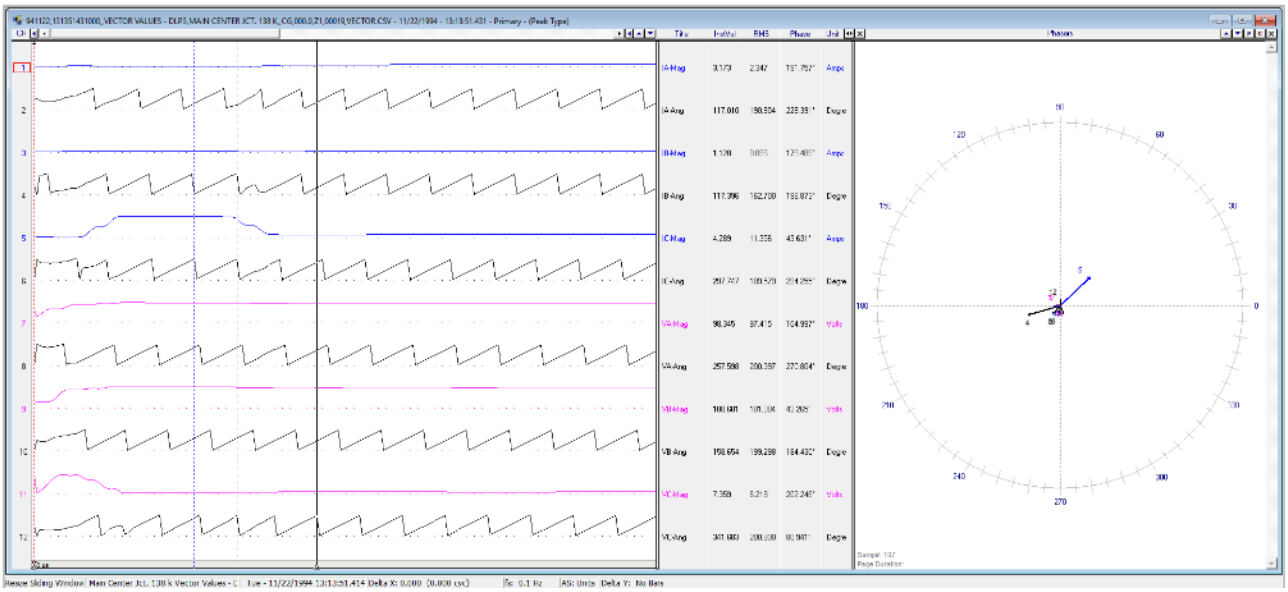


Figure 3.67 Save As: CSV Format - Vector Display

HARMONIC ANALYSIS REPORT

The harmonic analysis report runs the harmonic calculation on each channel from harmonics 0 (dc-offset) to the maximum harmonic (samples per cycle/2). To run the harmonic analysis report, select the Harmonic Analysis Report Icon under the Data tab. When selected the Harmonic Analysis dialog is displayed. Enter the harmonics above the percentage of fundamental to report on, the number of amps below to ignore during the analysis and the number of voltage below to ignore, Press the Run Report button to start the analysis.

The final report is an ASCII text file. The top section list the summary information for the file. The analysis report is in a table format and lists the following columns:

- Harmonic number,
- Date and Time the harmonic was first detected,
- Sample number the harmonic first detected,
- Magnitude at the Sample number (DFTPeak),
- Fundamental,
- Percentage of the fundamental,
- Duration how long the harmonics was detected.

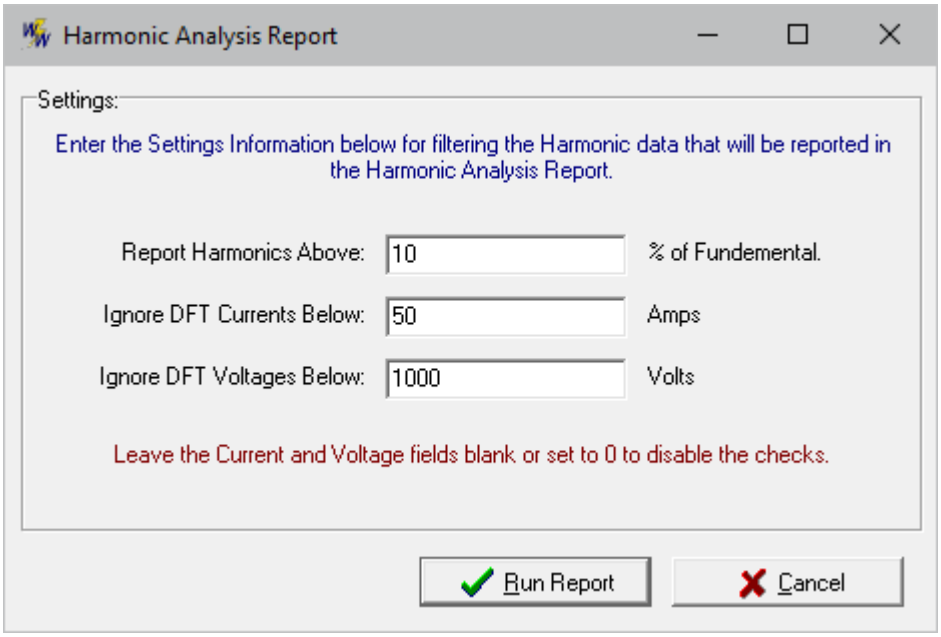


Figure 3.68 Harmonic Analysis Dialog

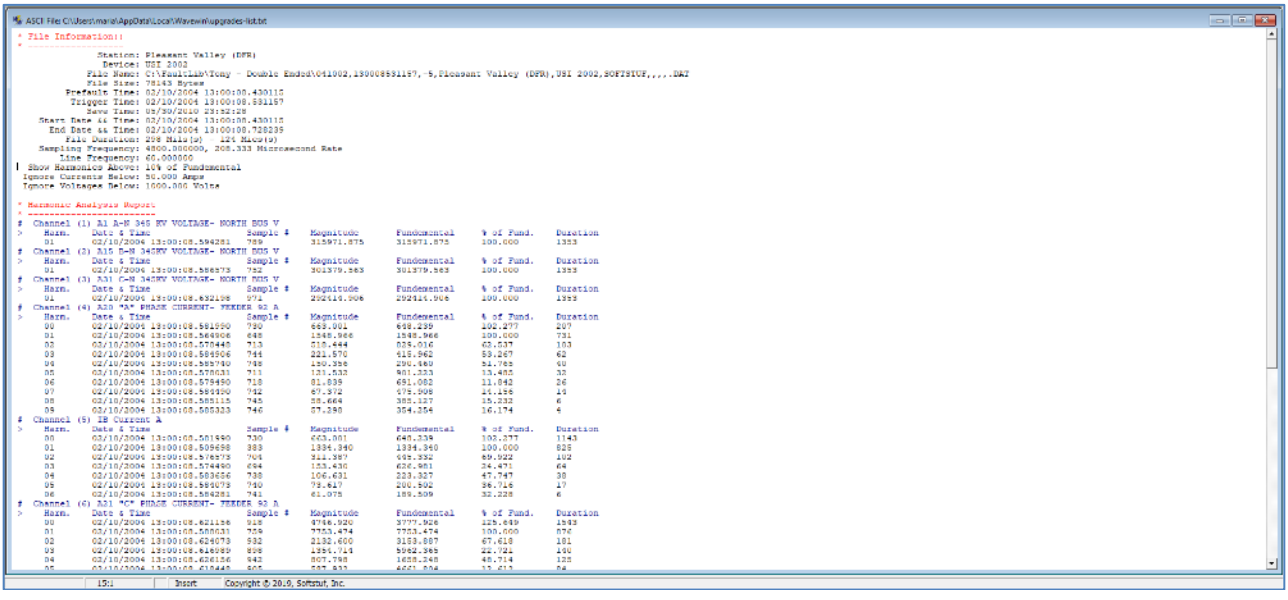


Figure 3.69 Harmonic Analysis Report

TVE CALCULATOR

The TVE (Total Vector Error) calculator is used to calculate the TVE for synchro phasor measurements. TVE is defined as the square root of the difference squared between the real and imaginary parts of the theoretical actual phasor and the estimated phasor. The equation used in the calculator is from the IEEE C37.118-2005 Standard, Equation # 2.

The TVE is calculated on the first displayed channel or the first marked channel. To mark channels, use the spacebar or mouse. Marked channels are displayed in red.

To open the TVE calculator select the TVE Icon under the Data tab. Once selected the TVE dialog is displayed.

The TVE dialog is a stay on top dialog allowing for the data bar to be moved in the data window while the dialog is open. When using the cursor keys to move the data bar make sure the data window is the active window. To populate the Measured values with the values at the data bar click the Refresh button. Enter the Actual values then click the Calculate button to show the TVE between the Actual values and the measured values. Click the Close button to close the dialog.

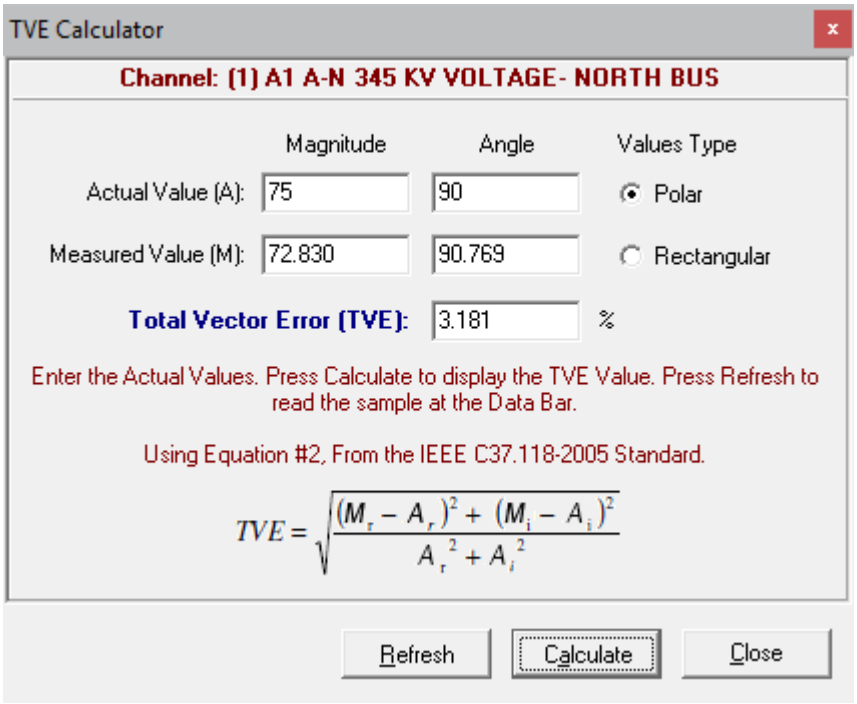


Figure 3.70 TVE Calculator

FREQUENCY CALCULATOR

The frequency calculator is used to measure the frequency between the reference bar and the data bar. To open the frequency calculator, select the Frequency Calculator Icon from the Data tab. Once selected the Frequency dialog is displayed in the upper right corner of the data plotting window.

The frequency dialog is a stay on top dialog allowing for the data bar to be moved in the data window while the dialog is open. When using the cursor keys to move the data bar make sure the data window is the active window. The Delta X values will be automatically updated when the data bar is moved in the data plotting window. Enter the number of cycles between the reference bar and data bar then click the Calculate button to show the frequency value. The number of cycles is displayed in the status bar in the Delta X field. Click the Close button to close the dialog.

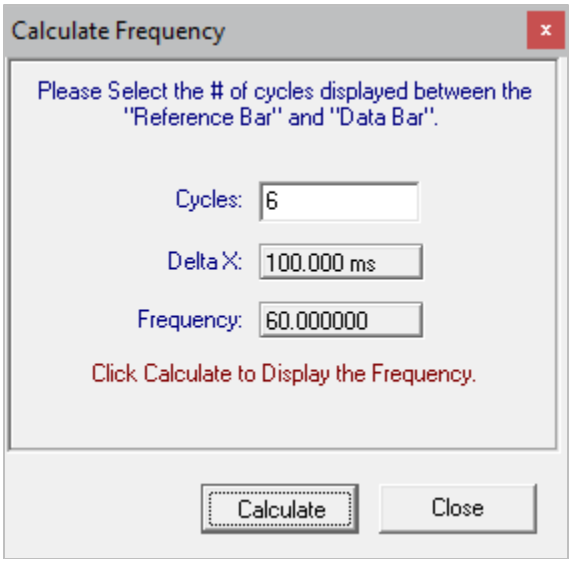


Figure 3.71 Frequency Calculator

SEMI F47-0706 VOLTAGE SAG CHART

The SEMI F47-0706 Voltage Sag display shows the sag immunity chart. The chart depicts the required voltage sag ride-through capability curve. The unaffected region is the green area, and the miss operation region is the red area.

To view the chart, click on the SEMI F47 option from the Channels menu/tab. If no channels are marked, the first 3 voltage channels will be automatically selected.

To the right of the chart is the sag percentage which is calculated for each voltage channel using the following equation: (Nominal RMS *100) / (Lowest Sag RMS). Each displayed percentage is followed by the channel number, the duration in milliseconds and the number of cycles.

The trigger value for the duration calculation is set in the System Settings dialog. The default setting is 15% of nominal.

The F47 plot will adjust according to the amount of time in the file.

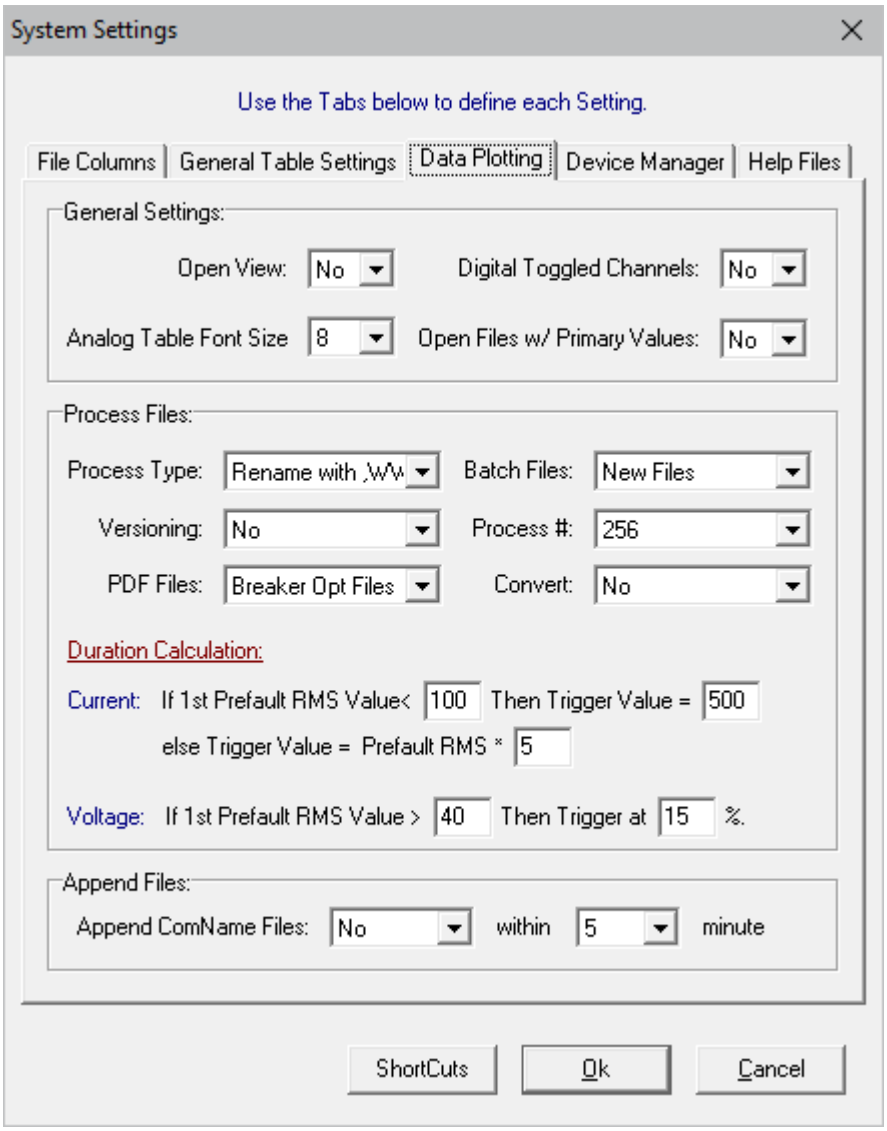


Figure 3.72 Duration Calculation – Voltage

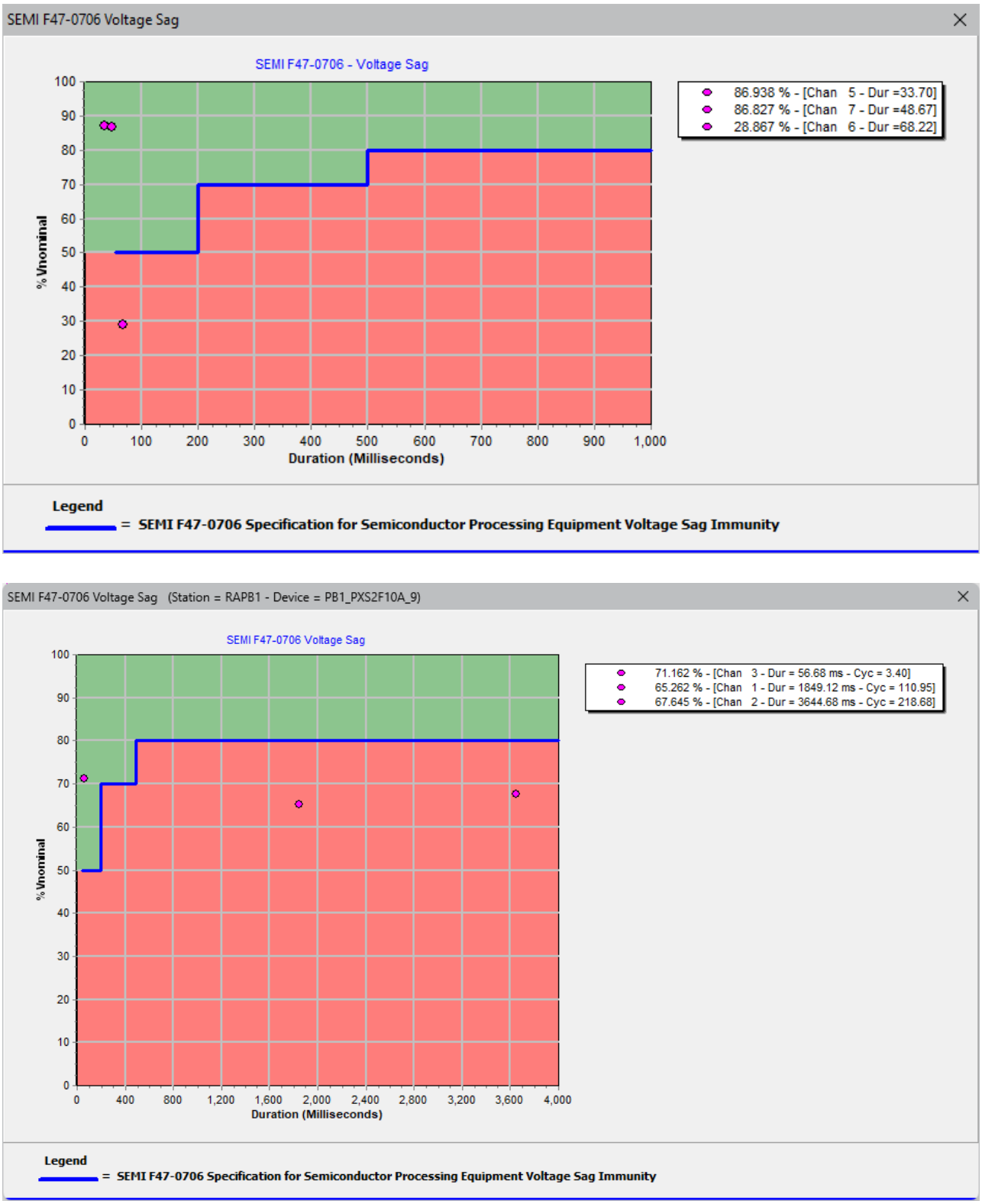


Figure 3.73 SEMI F47 0706 Voltage Sag Chart with 1 second of data and 4 seconds of Data

3-D PLOTS

The Plot 3-D feature plots a maximum of 3 channels in 3-D. To plot the channels in 3-D first mark the 3 channels then click on the Draw 3-D icon under the Channels tab. Viewing channels in a 3-D fashion allows for viewing power flow.

To open the 3-D Plot chart first mark the channels then click on the Draw 3-D icon under the Channel tab.

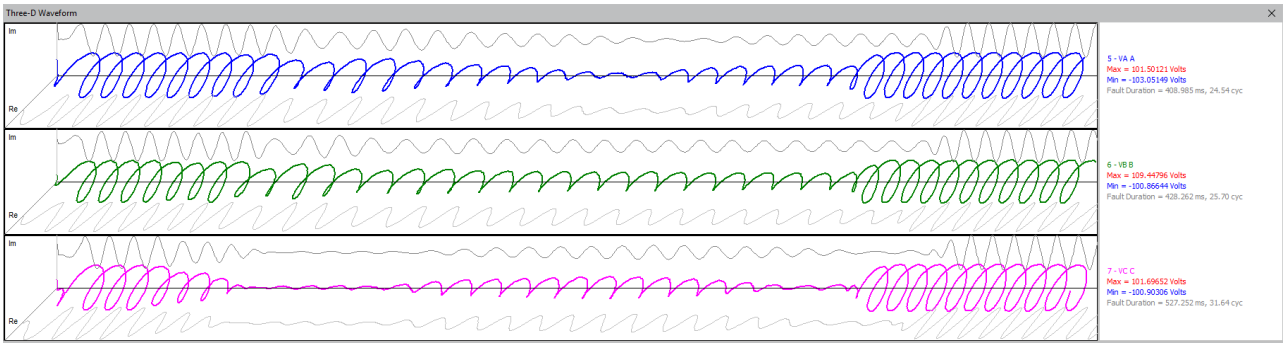


Figure 3.74 Plot 3-D

To the right of each channel is the channel number, the channel title, the instantaneous maximum and minimum values of the entire channel and the duration of the fault in cycles and milliseconds. The calculation for the duration is defined in the Display dialog located in the File Manager's Options tab. The values used in the duration calculation can be edited. The trigger values for the duration calculation are set in the System Settings dialog. The default setting is 15% of nominal for the voltage channels, and times 5 of nominal per unit for the current channels.

ROSE PLOTS

The Rose charts feature plots the waveform signal using the circular charts. To plot a rose chart, first mark the channels to plot then hit enter to isolate the channels. Next, click on the C button above the phasor diagram. The rose charts display a small circle the same color as the signal color if the value is a negative value. To return to the phasor display click on the P button above the rose chart.

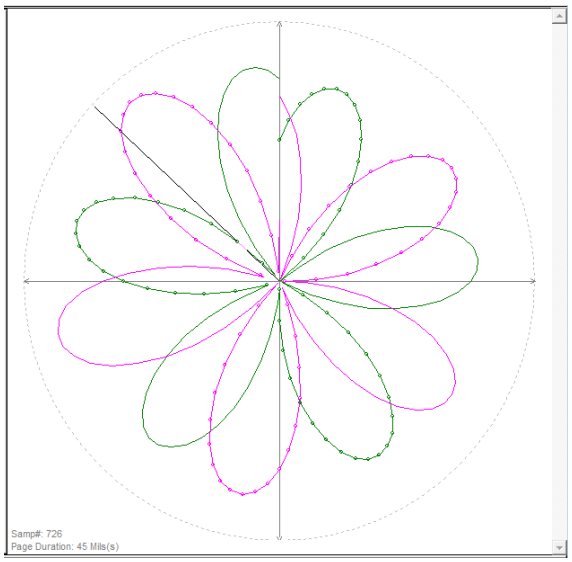


Figure 3.75 Rose Plots

DIGITAL CHANNEL GROUPS

To save digital groups in a view use the Save View dialog. When a record is open, Wavewin will only display the digital channels that changed state. When creating digital groups all of the digital channels may have to be displayed prior to opening the Save View dialog. Before opening the Save View dialog select the All-Digital icon under the Waveform tab. This will include all of the digital channels in the Save View dialog.

The Digital Groups section is disabled until the New Group button is clicked. To create a digital group, use the Mouse to select the digital channels in the Digital Channel's list box. Next, click on the New Group button. Once the New Group button is clicked the Digital Group section will be enabled and the Digital Group Name field will have the focus. Type in the name of the new group and hit enter or click the Save button. The table below the Digital Group Name field will be populated with the name of the digital groups in the first column and the number of channels in that group in the second column.

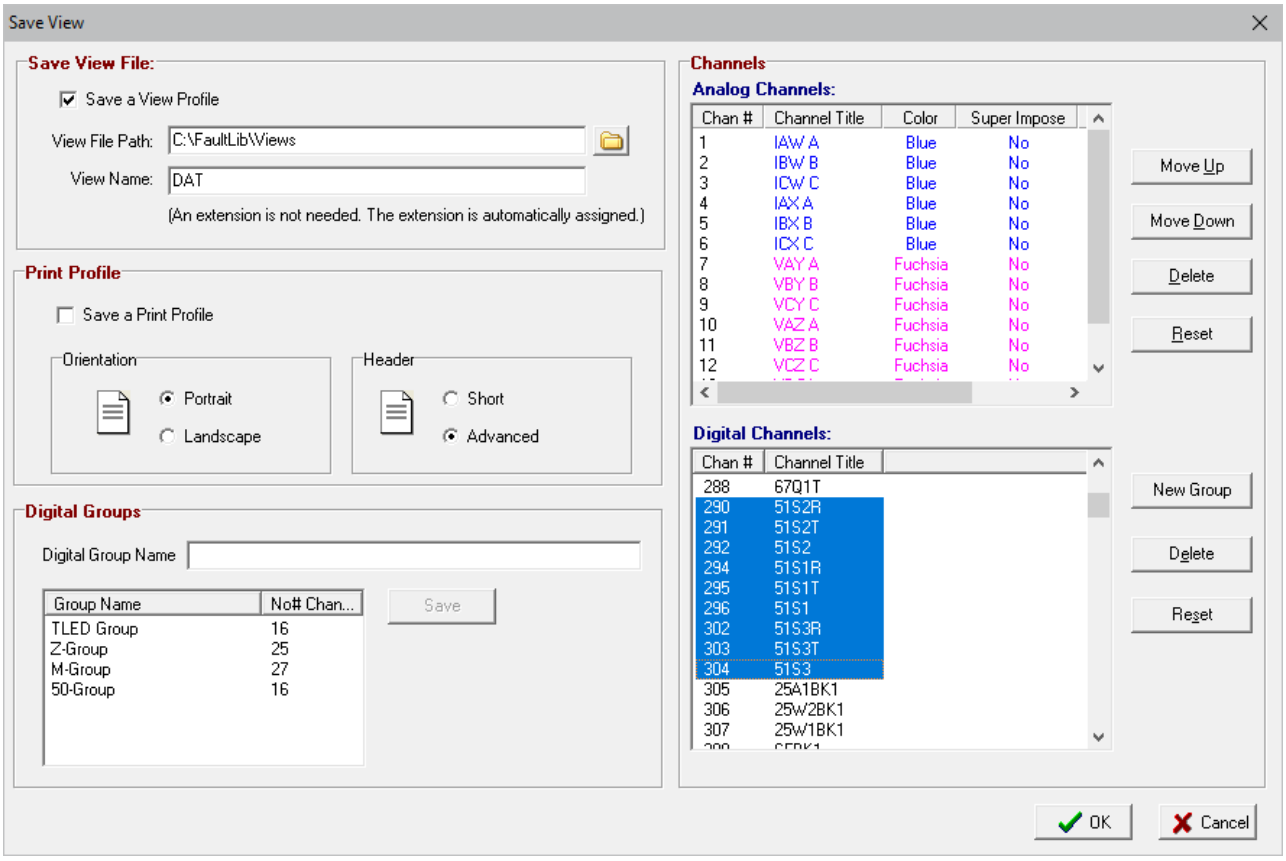


Figure 3.76 Save View – Digital Groups

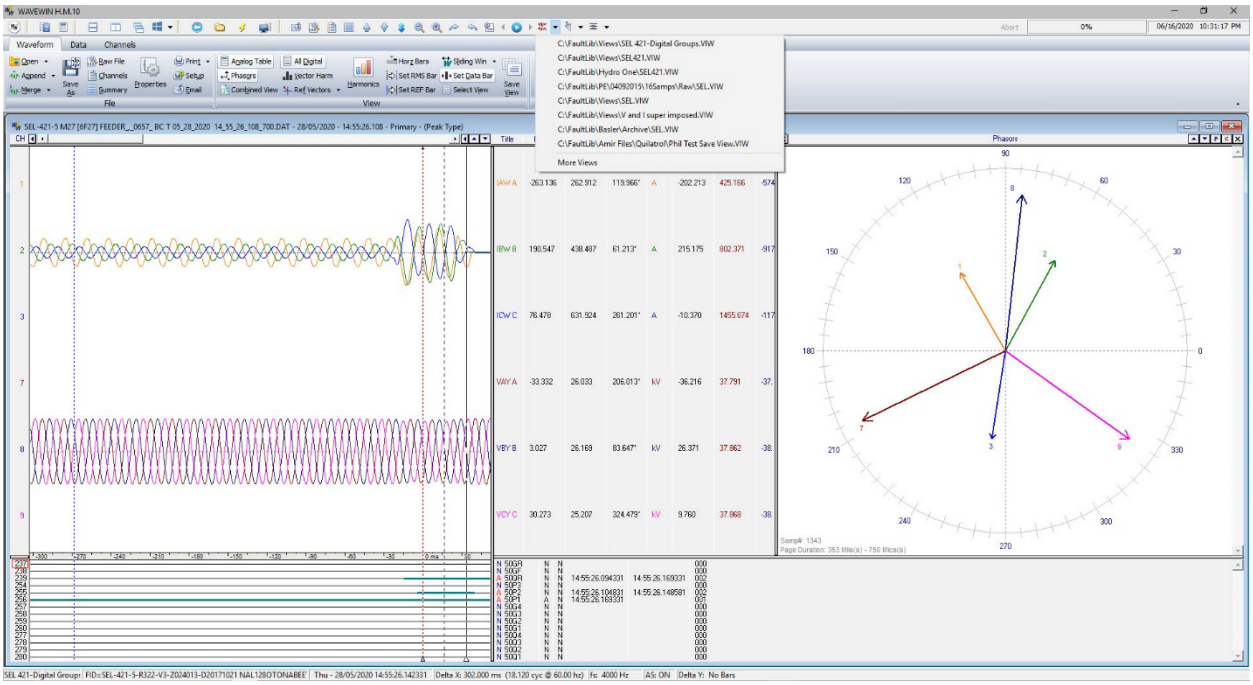


Figure 3.77 Select View

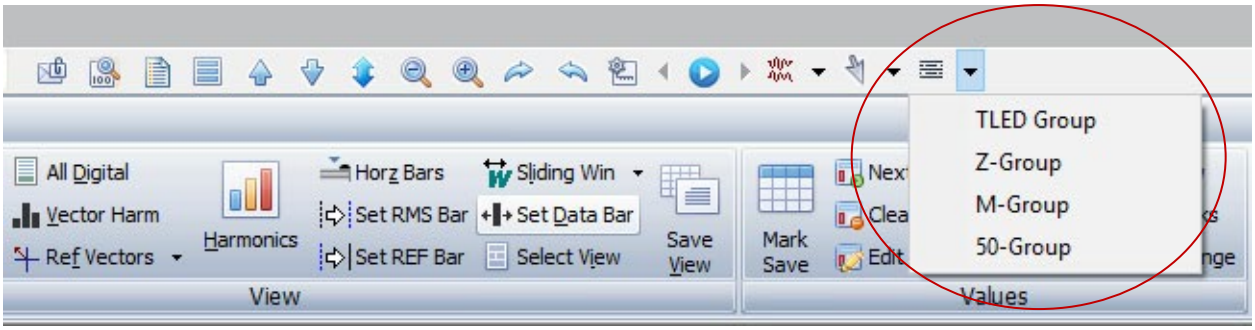


Figure 3.78 Digital Group Drop Down Menu

In the Data Plotting window select the View that was saved with the Digital Groups. A new drop down button is added to the Data Plottting main toolbar. The new drop down lists all the Digital Groups in the View. To display a digital group select the group from the drop down menu. By default Wavewin only displays the triggered digital channels for each group. To view all the digital channels in the group click on the All Digital icon under the Waveform tab.

A View can also be selected from the Select View Dialog. Click on the Select View icon under the Waveform tab. When the view is selected under the View Files section a new list is displayed next to the Digital Channel list box. It lists all the Digital Group Names and if the digital group is compatible with the displayed file. The group is compatible if it's digital number and name in the group match the digital channels name and number in the file.

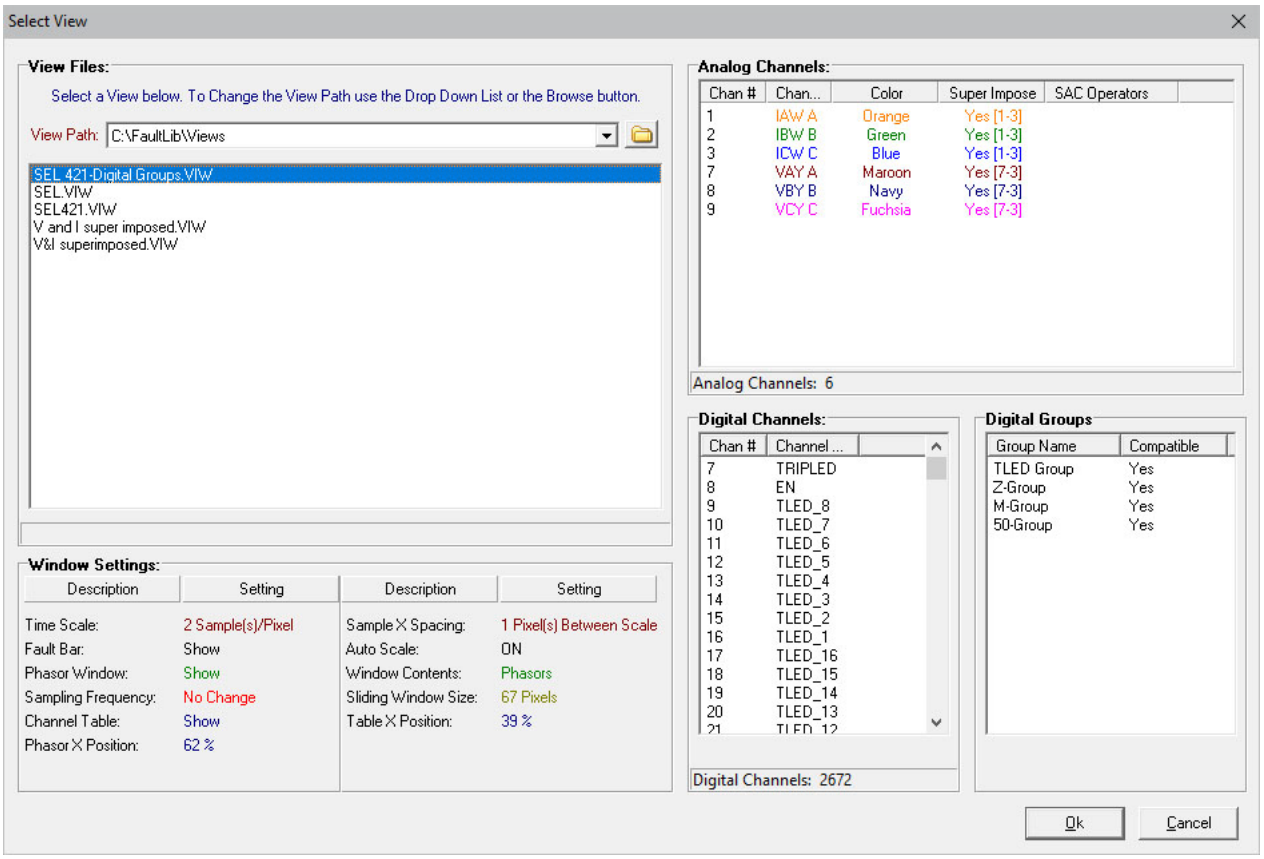


Figure 3.79 Select View Dialog

AUTO PLAY WAVEFORM

The Auto Play Waveform will play the waveform as an oscilloscope. In the ribbon system there are three buttons on the main toolbar and under the Data tab to Start/Stop the waveform and increase and decrease the speed of the waveform. In the menu system use the 3 menu options under the Data menu, Play Waveform, Decrease Speed, and Increase Speed. The Play Waveform will auto play the displayed analog and digital channels, phasors and any other dialogs open such as the harmonic window, Sequence Components window and the Power Harmonic Calculator. The analog and digital channels will move to the left keeping the data cursor fixed at one cycle from the beginning of the display. In the Ribbon system the button to the left of the auto play button is used to slow the speed of the waveform movement and to the right is a button to increase the speed of the waveform. In the Menu System use the menu items increase/decrease to control the speed of the waveforms.

All values in the tables and dialogs are the values at the data bar.

The Auto Play Waveform does extensive drawing to the screen. To minimize flicker and slow drawing select a maximum of 7 channels and expand the time scale to see a smooth transition when the analog channels are played. The drawing is done in the background. This allows for marking, deleting, expanding, contrasting, scaling channels and more while the Waveform is being played.

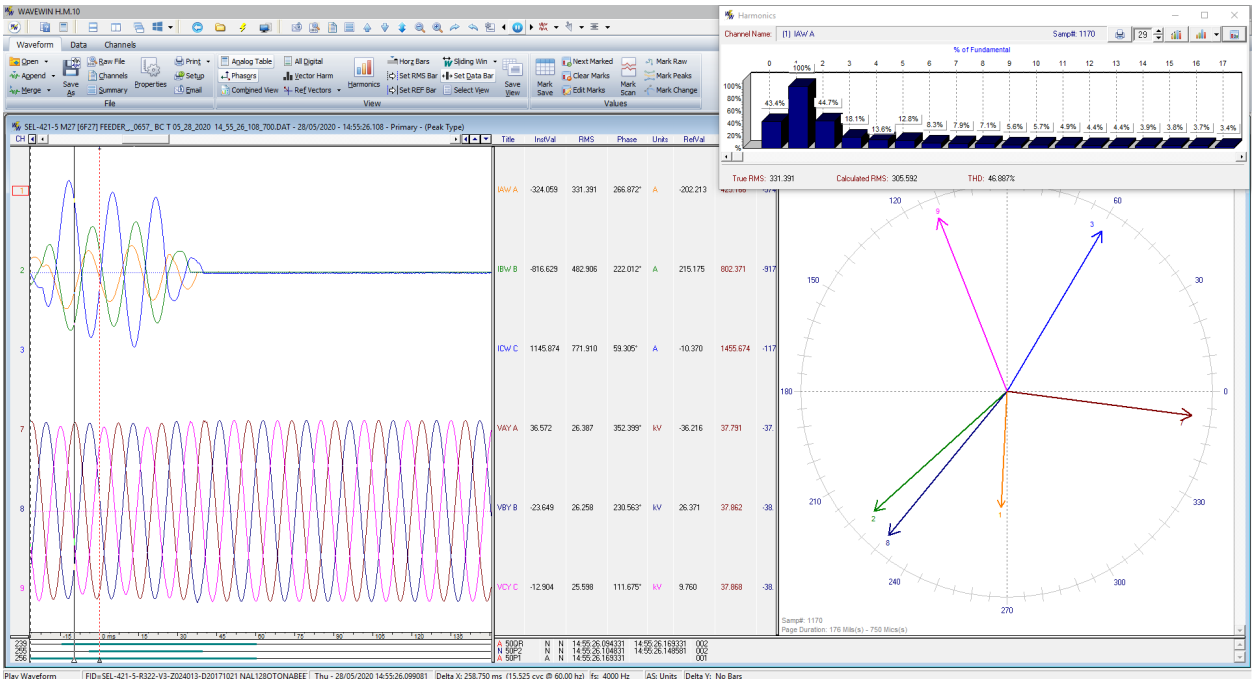


Figure 3.80 Auto Play Waveform

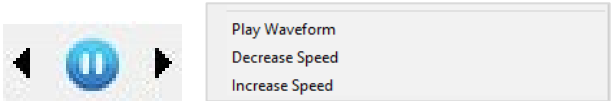


Figure 3.81 Auto Play Waveform Menu Buttons

SORT DIGITAL CHANNELS

The Sort Digital Channels will sort the displayed digital channels according to the first change of state. This feature will sort the first change in state in Ascending order or sort the first change in state in Descending order. There is also an option to restore the order of the Digital Channels when the file was first opened. In the menu system use the submenu under the Channels menu called Sort Digital Channels and in the ribbon system use the drop down menu in the Channel tab under the Arrange section.

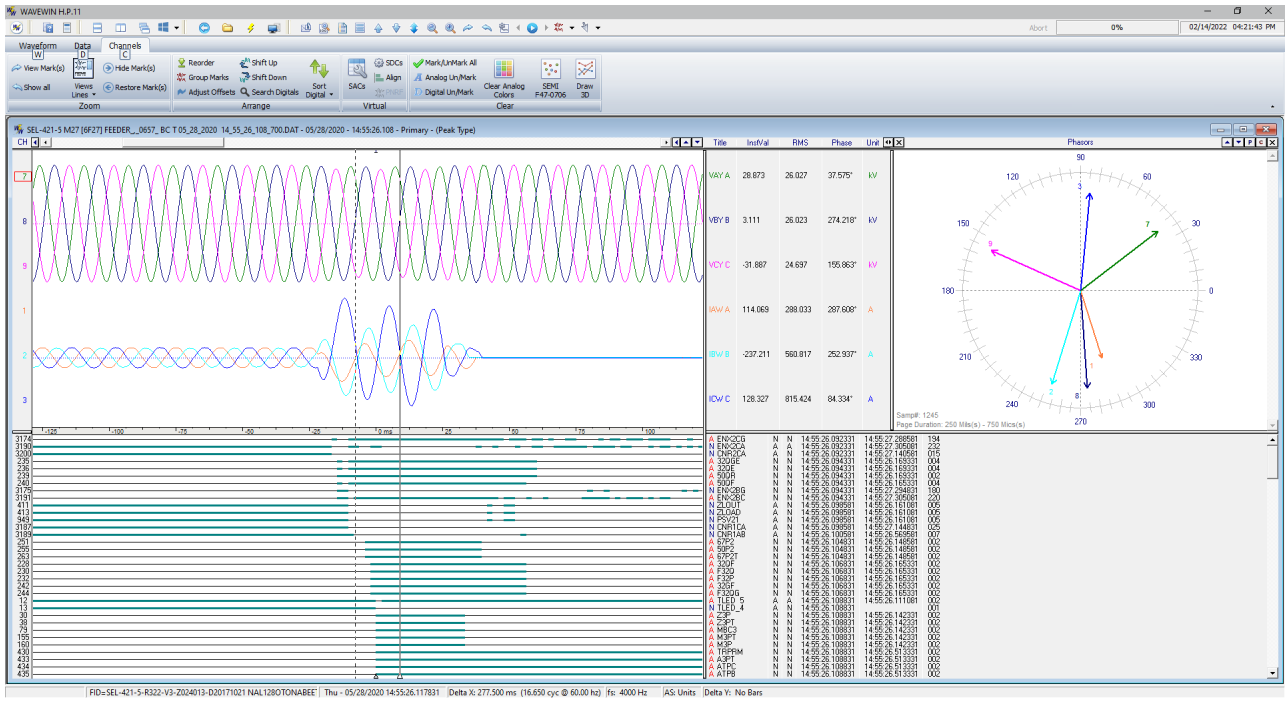


Figure 3.82 Sort Digital Channels Ascending Order

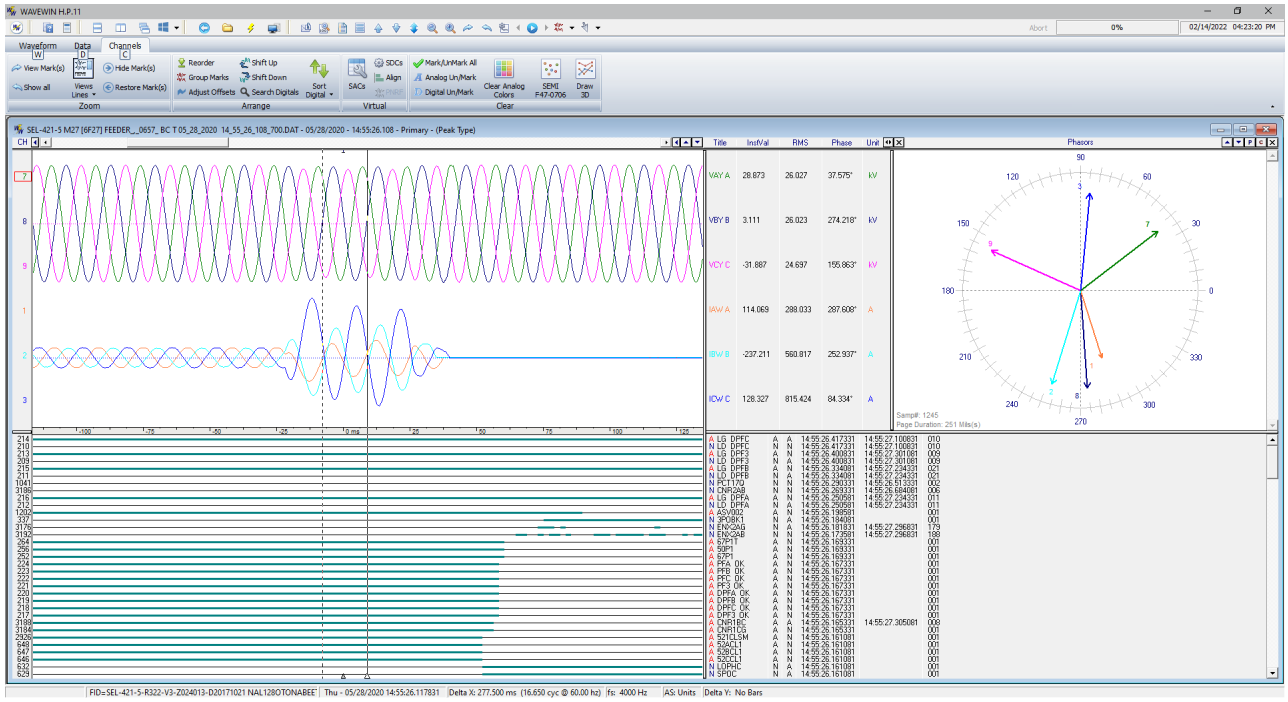


Figure 3.83 Sort Digital Channels Descending Order

RESTORE ORIGINAL VIEW

The Restore Original View will restore the analog channels, digital channels, phasors, and the analog table back to the original view when the file was first opened. To restore the original view select the Restore Original View menu option under the View menu in the Menu system or click the Restore Original View icon in the View section under the Waveform tab in the Ribbon System.

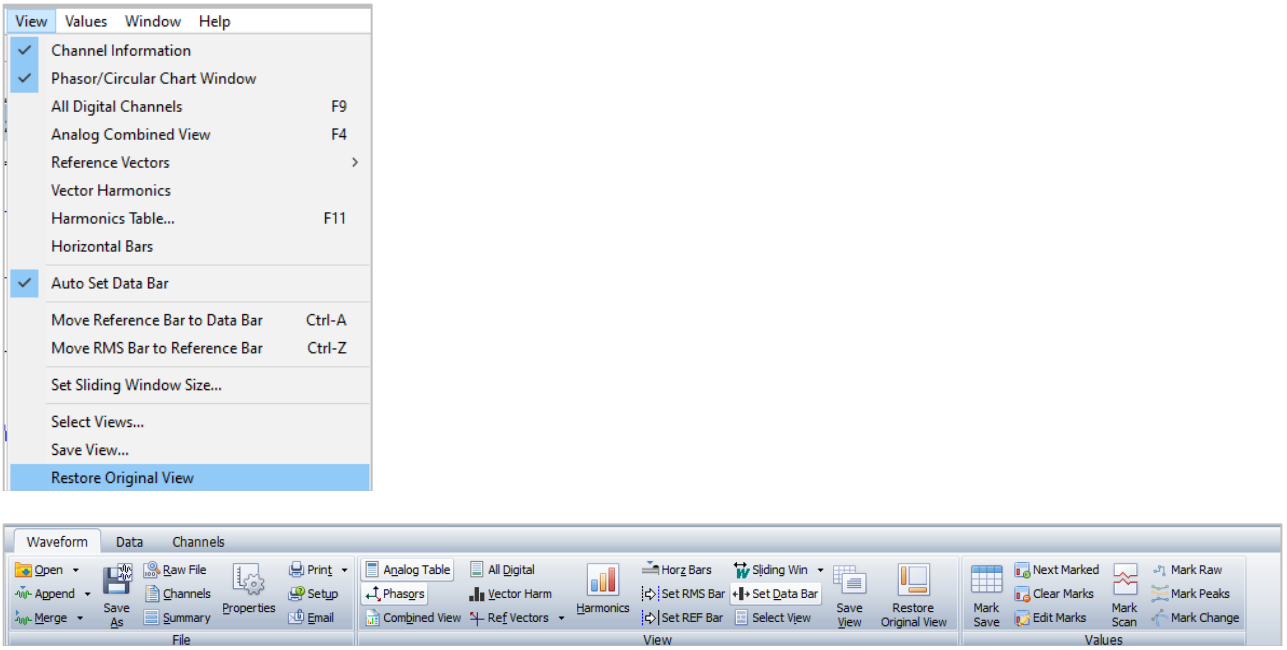


Figure 3.84 Restore Original View Menu Options

INVERT MARKED CHANNELS

The Invert Marked Channels will invert all the marked analog channels. To activate, first mark the desired analog channels using the spacebar or mouse. Next, right click on the analog channel table and select the Invert Marked Channels menu option. If there are no analog channels are marked then this option will be disabled.

All of the marked channels scale factor will be multipled by -1. To restore the original, mark the channels again and select the popup menu option Invert again.

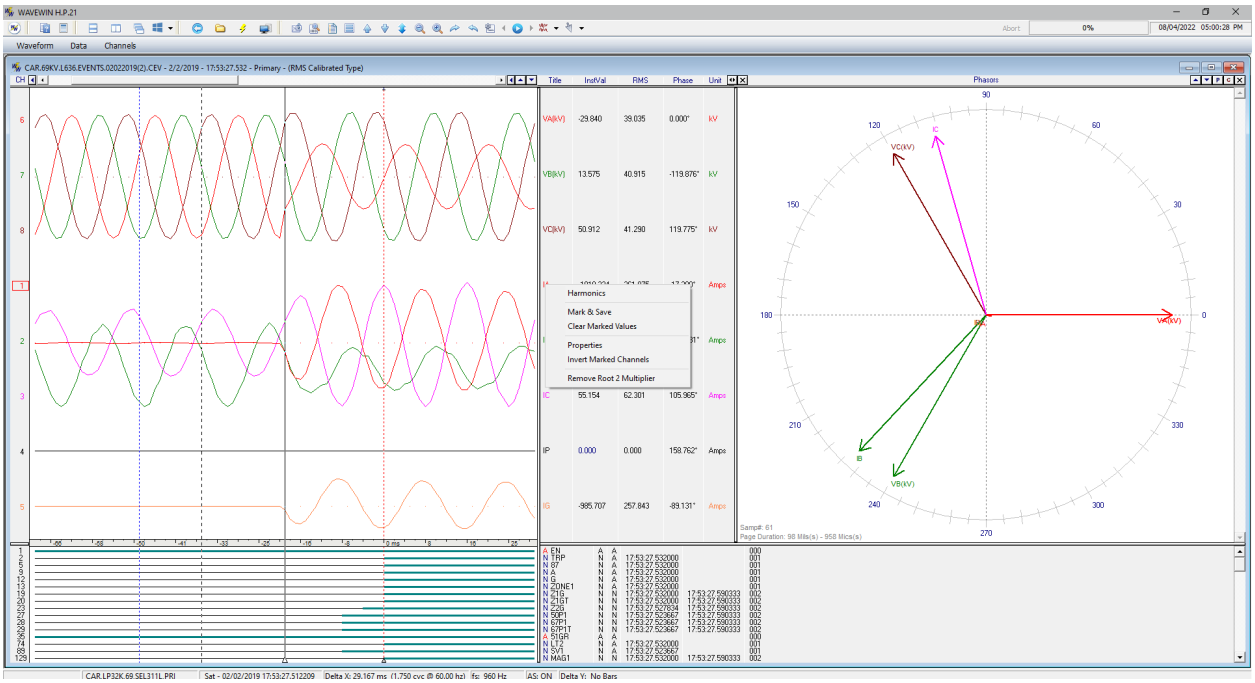


Figure 3.85 Invert Marked Channels Popup Menu

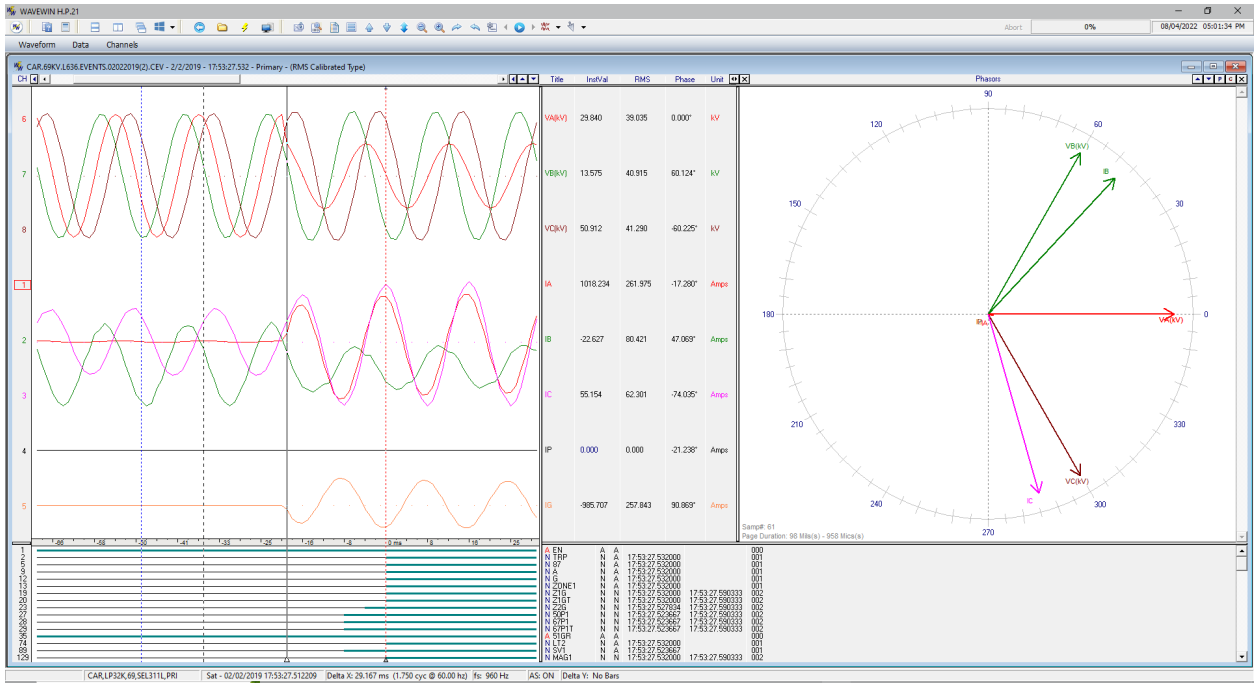


Figure 3.86 Inverted Analog Channels

SEL SPECFIC VIEWS

The SEL Specfic Views allows the user to save a view for each type of SEL Relay. The view can also be automatically applied when the SEL files are opened. To create the SEL views first select the SEL file in the File Manager. Next open a summary of the file by selecting Summaries under the Options Tab/Menu. The Device Type listed under the File Information section shows the name of the SEL view file.

```
* File Information:
* ------------------
            Station: MCC 202
             Device: MCC SUB
          File Name: C:\FAULTLIB\TEST\150428,070428709,-5,Station,SUB,Comp,AG,-XY.CEV
          File Size: 92496 Bytes
     Prefault Time: 4/28/2021 07:04:28.629834
        Fault Time: 4/28/2021 07:04:28.709000
         Save Time: 04/29/2021 07:47:06
      Process Time: 08/05/2022 13:36:37
  Start Date & Time: 04/28/2021 07:04:28.629834
    End Date & Time: 04/28/2021 07:04:29.692334
      File Duration: 1  Sec(s) - 62 Mils(s) - 500 Mics(s)
 Sampling Frequency: 240.000000, 4166.667  Microsecond Rate
    Line Frequency: 60.000000
       Device-Type: SEL-751A
```

In the above summary the SEL view must be named SEL-751A.VIW. To set up the view open the SEL file in the Data Plotting Window.

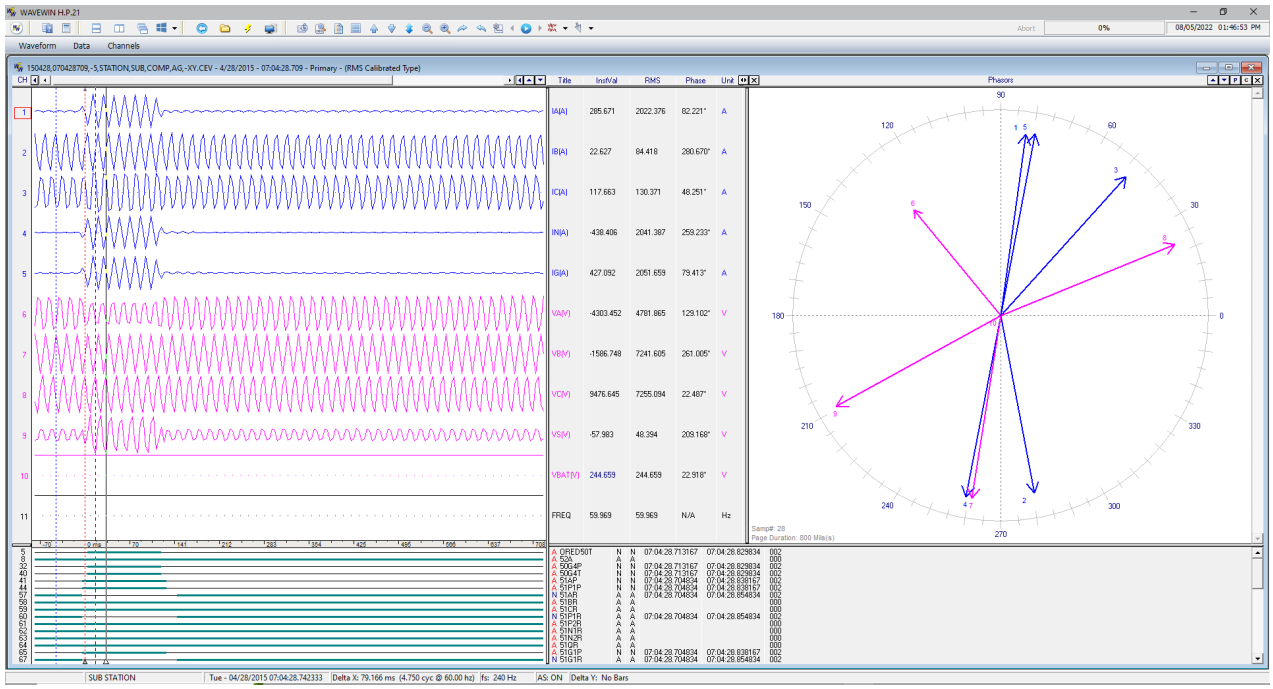


Figure 3.87 Open SEL File

Once the file is open setup the view.

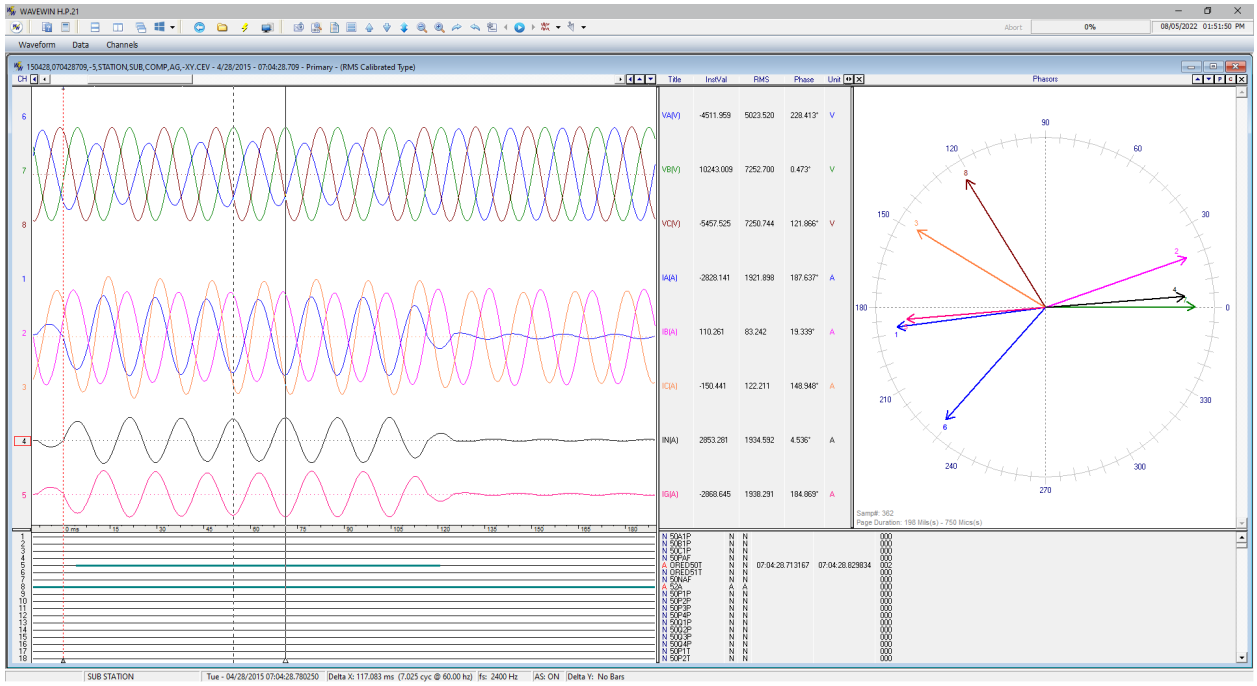


Figure 3.88 Setup SEL View

In the view above the voltage channels where moved to the top. The VS, VBAT and FREQ channels where deleted. Each channel was assigned a color and the sampling frequency was increased from 240 samples per second to 2400. The 3 voltage channels where super imposed and the 3 phase currents where super imposed. The analog channel table was resize to show Title, InstVal, RMS, Phase and Units. To move the analog table columns open the Properties dialog and select the Analog Table tab.

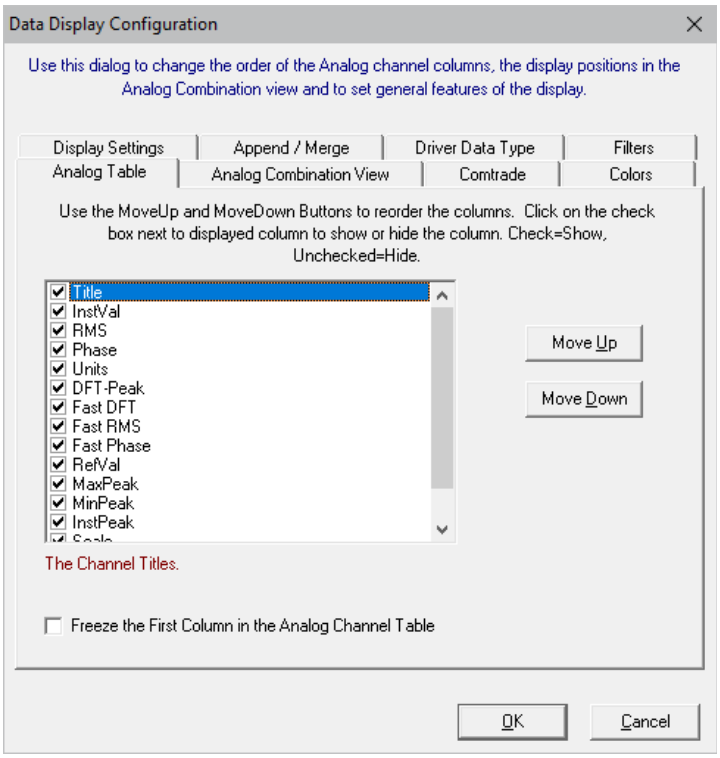


Figure 3.89 Properties Dialog/Analog Table Tab

When the View is complete select the Save View menu option under the Waveform tab.

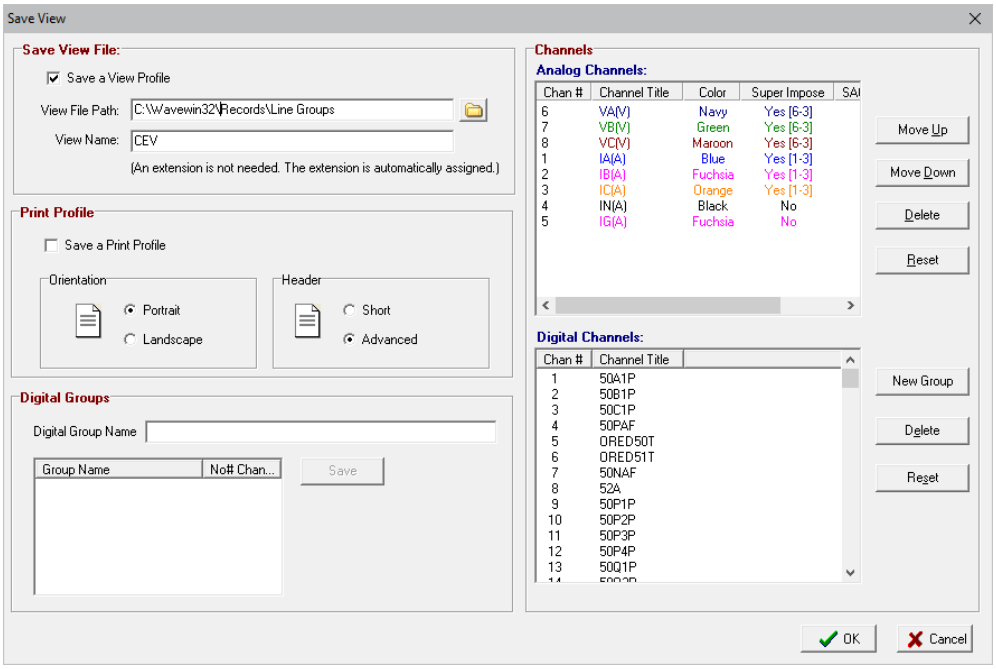


Figure 3.90 Save View Dialog

Enter the SEL Device type displayed in the Summary window: SEL-751A. The extension is not needed. It will be automatically assigned the .VIW extension. Select the path where the View will be saved in the

View File Path field. All SEL view files can be saved in a single path accessible to all Wavewin users. To set the path where Wavewin will look for the SEL view files select the Driver Config menu option under the Options tab in the File Manager.

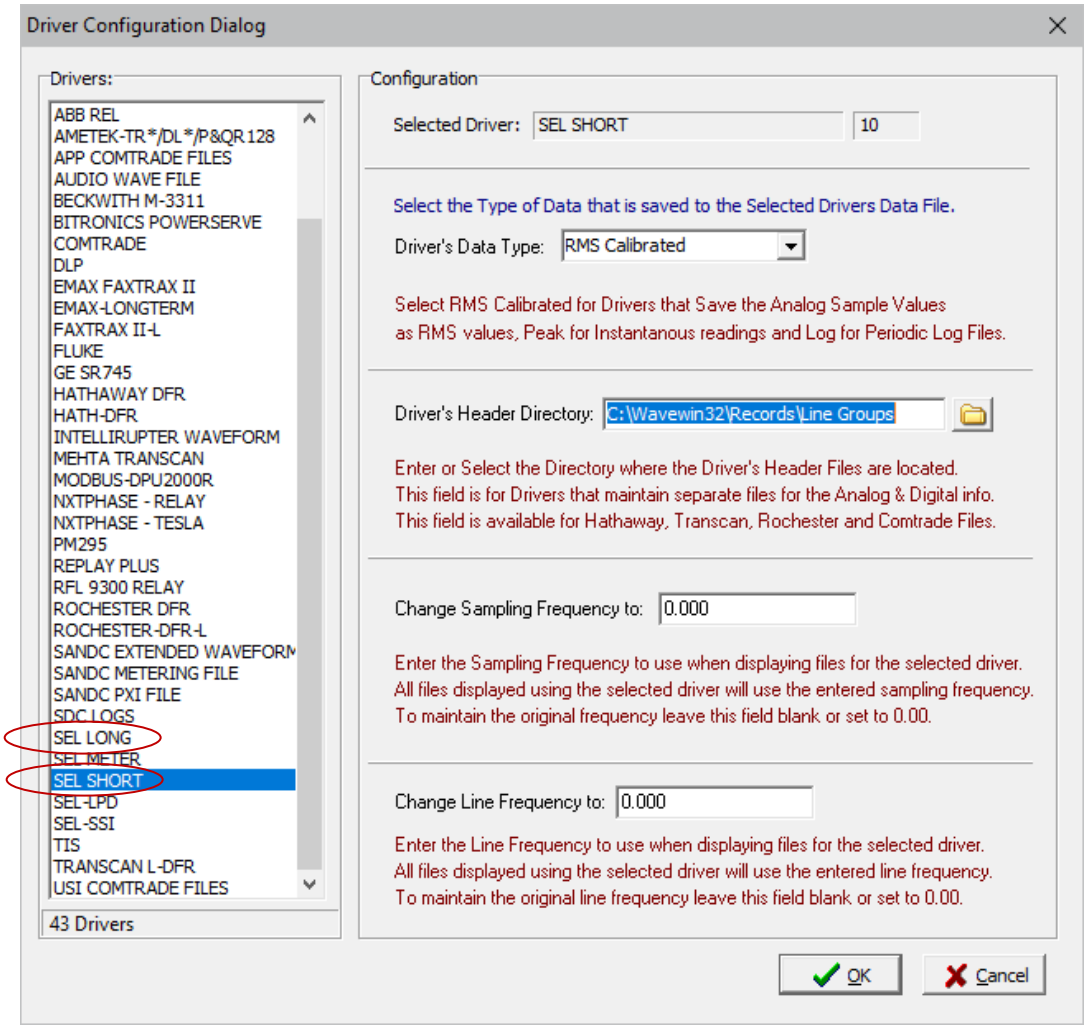


Figure 3.91 Driver Configuration Dialog

Set the Driver's Header Directory to the path where the SEL View files are saved. Set it for both the SEL Long and SEL Short drivers.

To have the view automatically opened when and SEL file is opened select the Display Properties menu option under the Options tab.

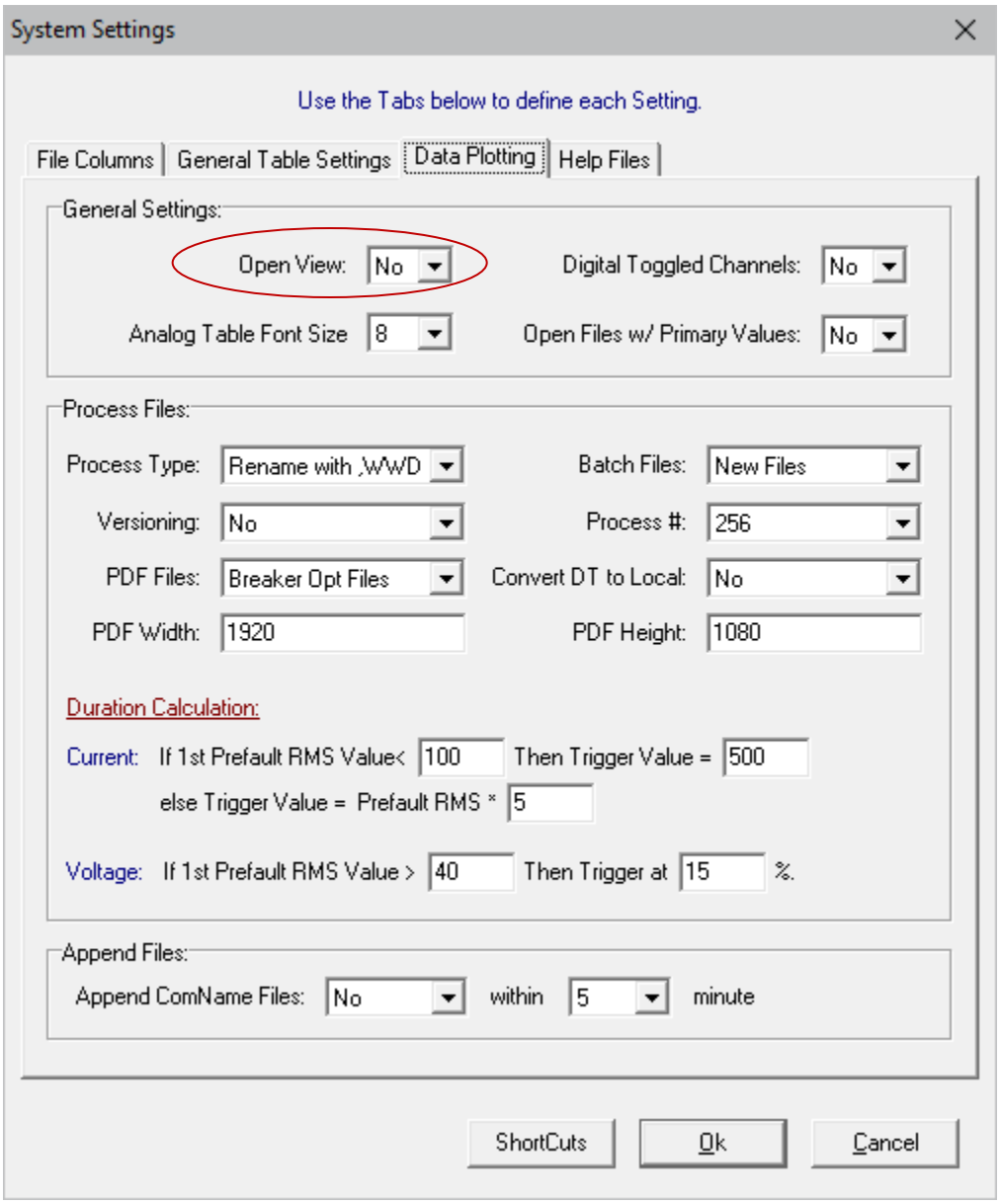


Figure 3.92 Display Properties Dialog

Select the Data Plotting tab. Change the first field, Open View, in the General Settings section to Yes. This setting will apply the SEL Views when the files are opened.

OPEN CFG FILE

The Open CFG file displays the contents of the Comtrade CFG file in an ASCII editor. This will allow for viewing or editing the contents of the channel configurations.

CALCULATED FAULT POSITION

The system calculates the fault inception when reading the samples values from the file. The fault inception is determined by the values entered into the Duration calculations inside the File Manager's Display dialog under the data plotting tab. To show the systems calculated fault inception bar and each channels fault inception position, open the Properties dialog inside the data plottting window. Click on the

Display Settings tab and select Yes for the Show Calculated Trigger Bar field and select Yes for the Chan Fault field. The calculated Fault Bar is position at the first channels calculated trigger. The calculated trigger bar is a purple dotted line with a fuschia triangle at the bottom of the bar. Each channels calculated poistion is depicted with a red dot.

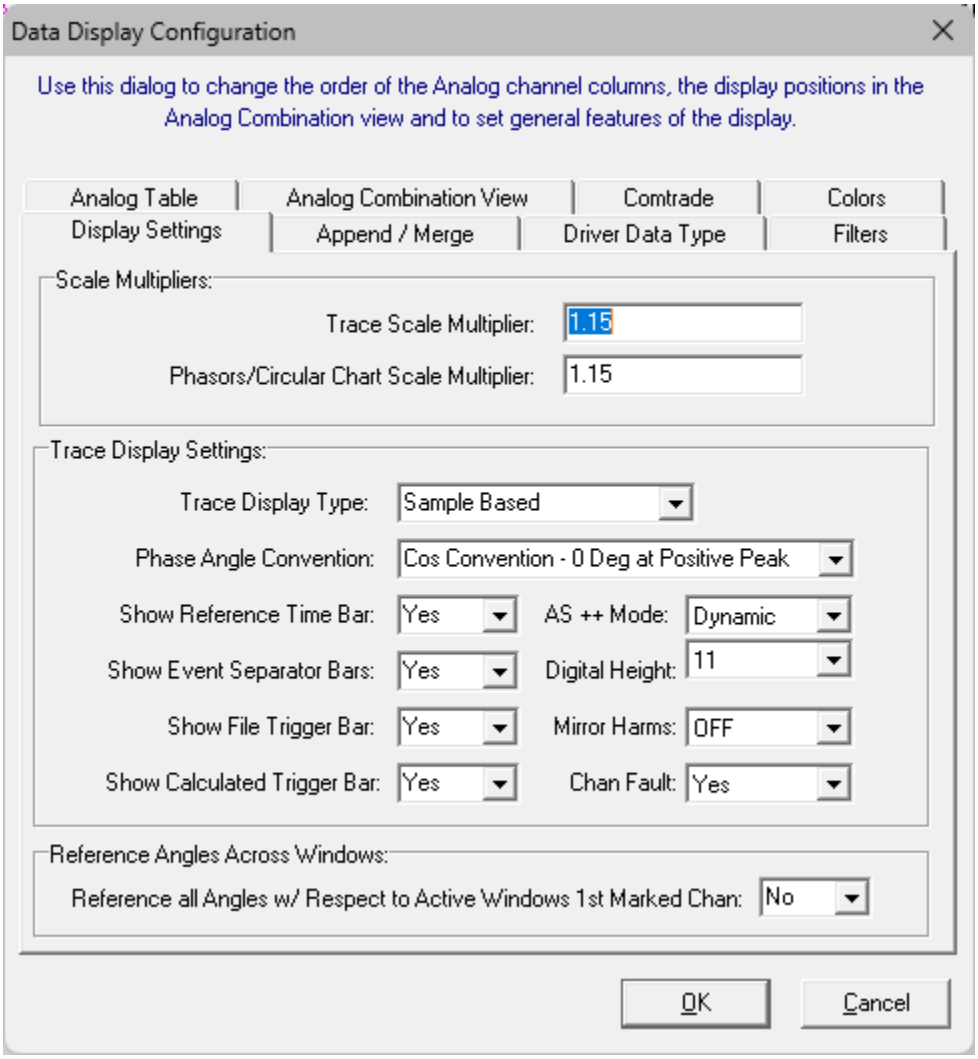


Figure 3.93 Data Plotting Properties Dialog

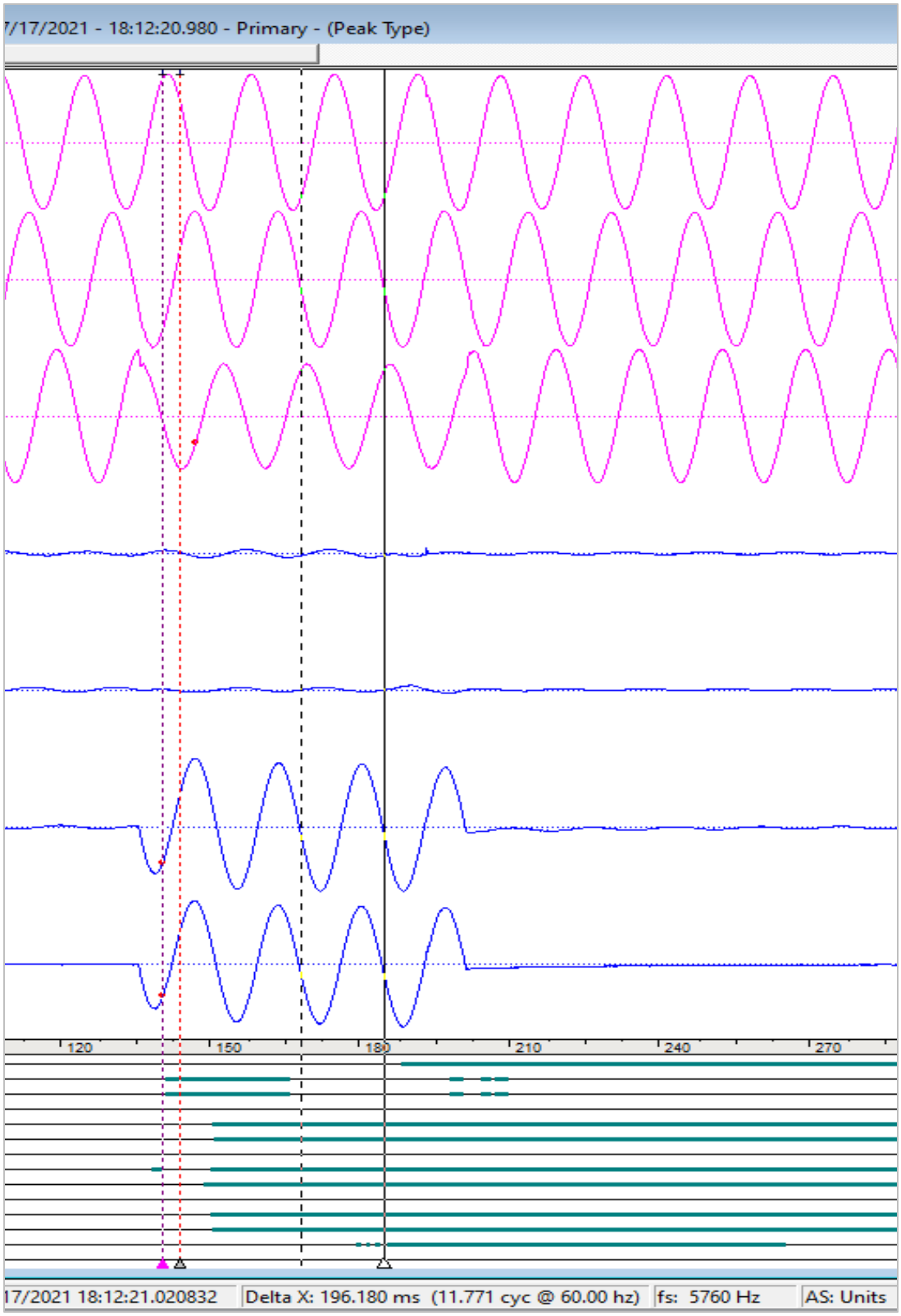


Figure 3.94 Calculated Trigger Position

A P P E N D I X A

System Keys

This section lists the function keys, cursor keys, and menu buttons available in the file manager, query fields and analysis window.

File Manager

Function Keys	Description
F1	Display the file table's help file.
F2	Display the file, at the cursor position in text format: ASCII Editor.
F3	Display the file, at the cursor position in hexadecimal format: Hex Editor.
F4	Display a list of the DAU-DEF station titles found in the active directory.
F5	Display the command line dialog to run an application.
F7	Change the active path to the specified destination path.
F8	Copy the marked files to the destination path.
F9	Move the marked files to the destination path.
F11	Display a sequence of events table for all the marked waveform files.
F12	Refresh the folder tree and the current directory

Cursor Keys	Description
Left Arrow	Move the cursor bar to the left one position.
Right Arrow	Move the cursor bar to the right one position.
Up Arrow	Move the cursor bar up one position.
Down Arrow	Move the cursor bar down one position.
Page Up	Display the files on the previous page.
Page Down	Display the files on the next page.
Home	Move the cursor to the first column in the file table.
End	Move the cursor to the last column in the file table.
Ctrl+Home	Move the cursor to the first file in the file table.
Ctrl+End	Move the cursor to the last file in the file table.
Tab	Move the cursor from the file table to the query fields.
Delete	Delete all the marked files and empty directories.
Enter	Run the driver at the cursor position.
Backspace	Change the active path to the previous directory.
Character keys	Move to the next row in the active column that starts with the entered character.

Menu Buttons	Description
 Exit	Exit Wavewin
 Help	Display the File Manager Help File.
 About	Display the About Window.
 Tile Horz	Tile the open Windows Horizontal.

Tile Vert	Tile the open Windows Vertically.
Cascade	Cascade all the open Windows.
Window	Display all of all open Windows.
Back	Go back to the previous window.
Files	Open or Bring to Front the File Manager.
Folder Tree	Show/Hide the Folder Tree.
Email	Email all the selected files with their support files.
Refresh	Refresh the folder tree and file manager.
Change	Change the Drive or Directory.
Up	Change the active folder to the parent folder.
Back	Change the active folder to the last navigated folder.
Copy To	Copy all selected files to a selected folder using the Microsoft's Copy dialog.
Move To	Move all selected files to a selected folder using the Microsoft's Copy dialog.
Mark	Mark all or UnMark all files in the File Manager.
Query All	Query all the file/folders in the File Manager with the entered Query Criteria.
Plot	Plot all the selected file, tile the windows horizontailly then minimize the file manager.
Edit	Edit the file at the cursor position.
Summary	Display asummary of the transiant file at the cursor position.

Query Fields

Function Keys	Description
F1	Display the query help file.
F5	Query all the marked devices in the active configuration.
F6	Query all the devices in the active configuration.
F7	Query all the unmarked devices in the active configuration.
F8	Clear the query criteria and set all the query operators to "=".
F9	Toggle through the available query operators for the active query field.

Cursor Keys	Description
Up Arrow	Return the cursor to the device table.
Right Arrow	Move the cursor one position to the right, wraps to next field at the end.
Left Arrow	Move the cursor one position to the left, wraps to next field at the beginning.
Tab	Move the editor to the next query field.
Shift+Tab	Move the editor to the previous query field.
Enter	Process the query criteria for all devices in the active configuration.

Menu Button	Description
Query	Query all devices in the active configuration.

Analysis

Function Keys	Description
F1	Display the data help file.
F2	Display the analog and digital channel information.
F3	Generate a max/min peak chart and an EN/SR summary log.
F4	Toggle between the available analog views.
F5	Display the software analog channel dialog.
F6	Turn channel amplitude auto scaling ON or OFF.
F7	Turn super imposing ON/OFF for all or marked channels.
F8	Mark or unmark all the visible analog/digital channels.
F9	Toggle between the available digital views (All or Triggered).
F11	Display the harmonics table.

Cursor Keys	Description
Left Arrow	Move the data bar to the left one sample.
Right Arrow	Move the data bar to the right on sample.
Ctrl+Right Arrow	Move the data bar to the next peak for the first display channel or the first marked channel.
Ctrl+Left Arrow	Move the data bar to the previous peak for the first display channel or the first marked channel.
Shift+Ctrl+Right Arrow	Move the data bar ahead one cycle for the first displayed channel or the first marked channel.
Shift+Ctrl+Left Arrow	Move the data bar back one cycle for the first displayed channel or the first marked channel.
Shift+Left Arrow	Shift the analog information table to the left by one column.
Shift+Right Arrow	Shift the analog information table to the right by one column.
Page Up	Page up through the data.
Page Down	Page down through the data.
Home	Move the data bar to the first data sample.
End	Move the data bar to the last data sample.
Ctrl+Up Arrow	Increase the amplitude for all or marked channels.
Ctrl+Down Arrow	Decrease the amplitude for all or marked channels.
Ctrl+Page Up	Expand the time scale for all visible channels.
Ctrl+Page Down	Condense the time scale for all visible channels.
Tab	Toggle between the analog and digital channels.
Up Arrow	Move the cursor up one channel.
Down Arrow	Move the cursor down one channel.
Shift+Page Up	Display the analog/digital channels on the previous page.
Shift+Page Down	Display the analog/digital channels on the next page.
Ctrl+Home	Display the first page of the analog/digital channels.
Ctrl+End	Display the last page of the analog/digital channels.
Spacebar	Mark or Unmark the channel at the cursor position.
Shift+Up Arrow	Mark or Unmark a group of channels while moving the cursor up.
Shift+Down Arrow	Mark or Unmark a group of channels while moving the cursor down.

Insert	Display the hidden channels that were removed by the delete keys.
Delete	Hide the marked channels and respace the unmarked channels.
Enter	Hide the unmarked channels and respace the marked channels.
Esc	Display all the hidden channels or exit the data window.
Backspace	Display all the hidden channels.
+	Shift all the marked channels up one position.
-	Shift all the marked channels down one position.
Ctrl-A	Move the reference bar to the sample at the cursor bar.
Ctrl-Z	Move the RMS bar to the sample at the reference bar.

Menu Buttons	Description
 Exit	Exit Wavewin
 Help	Display the File Manager Help File.
 About	Display the About Window.
 Tile Horz	Tile the open Windows Horizontal.
 Tile Vert	Tile the open Windows Vertically.
 Cascade	Cascade all the open Windows.
 Window	Display all of all open Windows.
 Back	Go back to the previous window.
 Email	Email the open file along with it's support files.
 Raw Date File	Open the raw data file in an ASCII or HEX Editor.
 Recorder Chans	View a lsi of all the analog and digital channels in the waveform file.
 Summary	View the Analog/Digital Summary of the active displayed file.
 Increase Amp	Increase the Amplitude of the marked or all channels.
 Decrease Amp	Decrease the Amplitude of the marked or all channels.
 ASV	Toggle through the available auto scales: ON/OFF/++/Units.
 Zoom In	Condense the time scale of the visible channels.
 Zoom Out	Expand the time scale of the visible channels.
 View Marked	Hide the unmarked channels and respace the marked channels.
 View All	Replot all the hidden channels.
 Properties	Display the Window Properties dialog.
 Select Views	Select a specific line or view from the drop down list.

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