AMETEK®

POWER INSTRUMENTS

DISPLAY STATION 32

OPERATION MANUAL

1086-339 Rev. A

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1. Introduction and Installation

This manual discusses the operations of the Ametek Fault Recorder suite of programs. This is comprised of:

- Display Station 32 and Display Station Analysis 32, which are packaged together. Display Station (DS) configures operations and Display Station Analysis filters and manipulates results for graphical display and analysis.
- An Expert System program for classifying fault data and working in concert with several dependant sub-components to filter, monitor results and manipulate those results for analysis, including:
  - Voltage Dips Analysis 32 to analyze the voltage fluctuations from recorders.
  - Distance to Fault, which uses an impedance model algorithm for fault analysis.
  - Breaker Performance Monitor (BPM), which records the operations of switchgear to monitor which breakers are due for servicing due to accumulative contact wear.

Introduction

DS32

Display Station 32 (DS32) provides communication, configuration and file handling functions. Although DS32 is designed to work with a range of AMETEK products, not all functions are available on all instruments and this is indicated where necessary in the text. For this reason some of the displays may not look exactly like those shown in this manual. References to the TR100 also include the DL8000 and references to the TR2000 also include the MFR. The TR100+ is an enhanced version of the TR100.

DS32 supports Pseudo Machines (PM). These are recorders of up to 160 channels that are made up from standard systems. DS32 makes the individual recorders look like a single large machine.

DS32 supports:

- Multiple modems and dial up networking. This means that auto-poll and auto-call are quicker since many recorders can be contacted at once.
- Windows services to add new modems and dial up networking capability. Details for configuring these options are given in Appendix B "3Com 56k LAN Modem Configuration: Manual and Autopolling" and Appendix C "DS32 3Com/Remote TR 3Com LAN Modem Connection Configuration (Autocall)". These processes improve the response of the system

DS32 Analysis

DSA32 displays analog and digital signals from AMETEK recorders for analysis. DSA supports:

- Transient, disturbance and logger records from the TR100, DL8000, TR100+, TR2000 and PQR series.
- Records stored in the IEEE COMTRADE format.
- Import of records from the Rochester TR1600 series of recorders using the translator program TRTrans.

Analog and digital signals appear together with their channel names and instantaneous values, if required. The digital channels are interleaved between the analogs and appear as a thin green line for the normal state and a thick red line for the alarm state. This is similar to the printed record format from a TR100 or TR2000.

When DSA32 is started the channels from the record are split into graphs with up to eight channels each. If there is a frequency channel it has a graph of its own. The graph that appears is the last in the list of graphs. This is channels 24 - 32 for a 32 channel transient record and the frequency channel for a logger record. Each channel is automatically scaled to fill the space available and channels in the same phase group initially have the same scale factor.

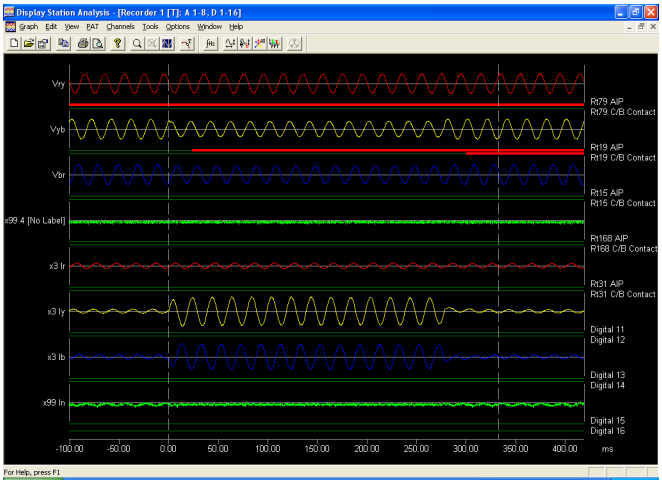

Figure 1.1 DSA Main Window

DSA has the following features:

- Zoom and panning features and the gain of each channel are individually adjustable.
- Two separately adjustable cursors to measure normal and differential amplitude and time values.
- Several graphs can be created with different channels of interest in each. These graphs are displayed individually, cascaded or tiled in the same way as other Windows™ based applications.
- Graphs can be printed using a wide range of printers and plotters. An extra line of text is added to these graphs that includes the location and name of the originating recorder and the time and date of the record. This is to identify the source of the printed output.
- The record header information, analog and digital profiles, is viewable directly from within DSA32.

- Extra channels are created by combining existing channels using simple arithmetic (+,-,* or /) or computing functions like RMS, sequence components, power and impedance. These new channels are treated in the same way as the original channels. These functions are available for both transient and disturbance records.
- Disturbance records contain the RMS and phasor information for each channel at up to 2 samples per cycle for triggered records and up to one sample per two cycles from a TR2000 disturbance logger record. The RMS data appear in graphical form and the phasor values are used to compute the derived components.
- Logger records have up to 34 channels of the maximum, average and minimum true RMS input values for each logging interval. There is also a record of the max, min and average frequency on the channel that is specified for frequency triggering. Records from a TR2000 recorder have two frequency channels. Separate logs of imbalance (or NPS), flicker, and power can also be displayed in DSA32. For harmonic logs a separate application is used.

Display Station Main Window

The Display Station main window (Figure 1.2) lists all of the data records on the system using a series of four tabs to separate the records by type. You can select a record for viewing and analysis in Display Station Analysis. A right-click menu offers access to various main menu or individual window-based function.

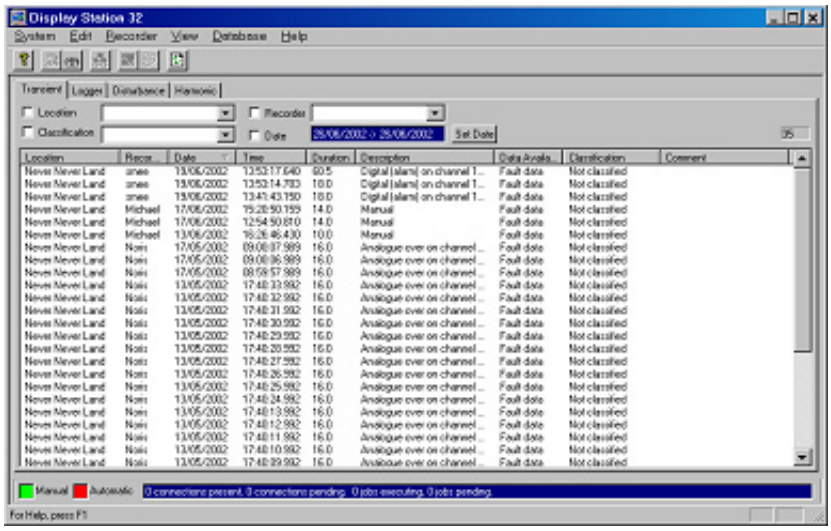

Figure 1.2 Display Station Main Window

The Display Station main window:

- Filters records - Records filtering is available by location, classification (fault type), recorder and date (applicable to individual or all records). Filter settings and sort settings apply only to the present program session. Column widths are stored permanently. See "Main Menu Bar" on page 2-6.
- Status bar - Displays the status of communications with recorders. As DS32 can support multiple modems, there can be several connections at once. See "Comms Manager" on page 2-23.

Record Types Available

Display Station and Display Station Analysis works with the following records and recorders:

Transient Records

Double-click on a record and the record window appears with the header information for the record and allowing for a comment to be stored with the record. This window also contains the following information:

- *Recorder Identification*- the name and location of the recorder where the record originated.
- *Trigger Information* - describes the trigger type that caused record generation with the originating analog or digital channel name. Also shows the time that the trigger was detected to the nearest millisecond. For the TR2000, this time is shown to the nearest microsecond. The date includes the day number in brackets. The type of time the recorder is locked in appears:
  - *GPS locked* - GPS time
  - *Serial locked* - Serial time code, which includes IRIG-B
  - *Internal clock*
- *Record Length* - shows the entire duration of the record in cycles.
- *Comment* - Display a message you can store appended to the record. This is also included with a printed version of the record. The comment is normally used to identify the cause of the fault record. See ″Paste comment″ on page 2-29.
- *Analyze fault data* - Opens the waveforms and analyzes the record further using Display Station Analysis (DSA). See Chapter 3 ″Display Station Analysis 32 Menus and Operations″.
- *Analogs* - Opens the pre and post fault RMS levels for each input channel in the record. The maximum and minimum values also appear. The measurement points are the two cycles either side of the trigger point and either side of the safety point

- *Digitals* - Displays the record's digital transitions the nearest millisecond. The fault duration also appears - the time between the trigger and safety points.
- *Expert Info* - Opens the Expert System classification of the record. This is only available if the record has been analyzed. See Appendix A "Expert System".
- *Expert System* - Starts the Expert system application. If the substation model has been created, this classifies the record and makes specific measurements. It is also used to view RMS profiles of individual channels or phase groups.

Logger Records

Double-click on a record and the record window appears with the header information. This window also contains the following information:

- *Recorder Identification*- the name and location of the recorder where the record originated.
- *Record Information* - start and end time to the nearest interval. The interval being the sample interval at which the logger data was recovered.
- *Duration* - the difference in the start and end times of the record.
- *Comment* - Display a message you can store appended to the record. This is also included with a printed version of the record. The comment is normally used to identify the cause of the fault record. See "Paste comment" on page 2-29.
- *Analyze* - Opens the waveforms and analyzes the record further using Display Station Analysis (DSA). See Chapter 3 "Display Station Analysis 32 Menus and Operations".
- *Transient Events* - Available for logger records containing high speed transient events.

Disturbance Records (TR2000, TR100+ & PQR)

Double-click on a record and the record window appears with the header information. This window also contains the following information:

- *Recorder Identification*- the name and location of the recorder where the record originated.
- *Trigger Information* - describes the trigger type that caused record generation with the originating analog or digital channel name. Also shows the time that the trigger was detected to the nearest millisecond. For the TR2000, this time is shown to the nearest microsecond. The date includes the day number in brackets. The type of time the recorder is locked in appears:
  - *GPS locked* - GPS time
  - *Serial locked* - Serial time code, which includes IRIG-B.
- *Analyze* - Opens the waveforms and analyzes the record further using Display Station Analysis (DSA). See Chapter 3 ″Display Station Analysis 32 Menus and Operations″.
- *Analogs* - Opens the pre and post fault RMS levels for each input channel in the record. The maximum and minimum values also appear. The measurement points are the two cycles either side of the trigger point and either side of the safety point
- *Digitals* - Displays the record's digital transitions the nearest millisecond. This is only valid for the TR2000 and TR100+. The fault duration also appears - the time between the trigger and safety points.
- *Expert Info* - Opens the Expert System classification of the record. This is only available if the record has been analyzed. See Appendix A ″Expert System″.

- *Expert System* - Starts the Expert system application. If the substation model has been created, this classifies the record and makes specific measurements. It is also used to view RMS profiles of individual channels or phase groups.

Digital Input transitions (TR2000 & TR100+)

This window shows the digital transitions that occurred during a disturbance record. This window also contains the following information:

- *Filter Selection* - select a channel to filter on. This is filtered by time range.
- *Event List* - lists the digital events, the type of transition: Normal or Alarm and the initial state of each input. The time shown is the same as the trigger time.

Harmonic Record

Double-click on a record and the record window appears with the header information. This window also contains the following information:

- *Recorder Identification*- the name and location of the recorder where the record originated.
- *Record Information* - start and end time to the nearest interval. The interval being the sample interval at which the logger data was recovered.
- *Duration* - the difference in the start and end times of the record.
- *Analyze* - Opens the waveforms and analyzes the record further using Display Station Analysis (DSA). See Chapter 3 ″Display Station Analysis 32 Menus and Operations″.
- *Comment* - Display a message you can store appended to the record. This is also included with a printed version of the record. The comment is normally used to identify the cause of the fault record. See ″Paste comment″ on page 2-29.

Installation

To install DS32 and DSA from the CD:

1. Insert the CD and the installation commences and the splash screen appears (Figure 1.3).

Figure 1.3 Splash Screen

2. Click **Next** and the license agreement appears (Figure 1.4).

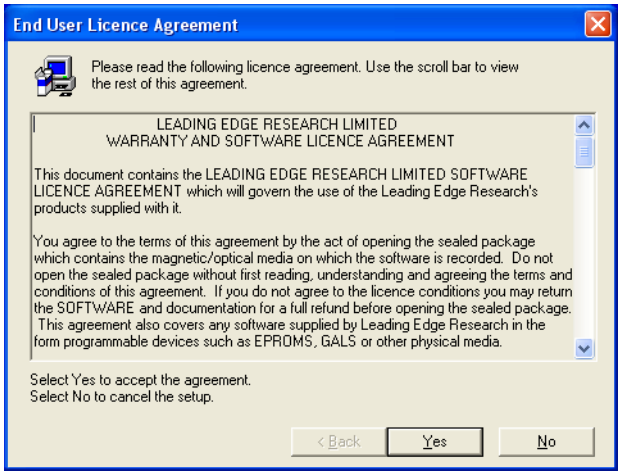

Figure 1.4 End User License Agreement

3. Read the agreement and click **Yes** and the User Registration Information window appears (Figure 1.5).

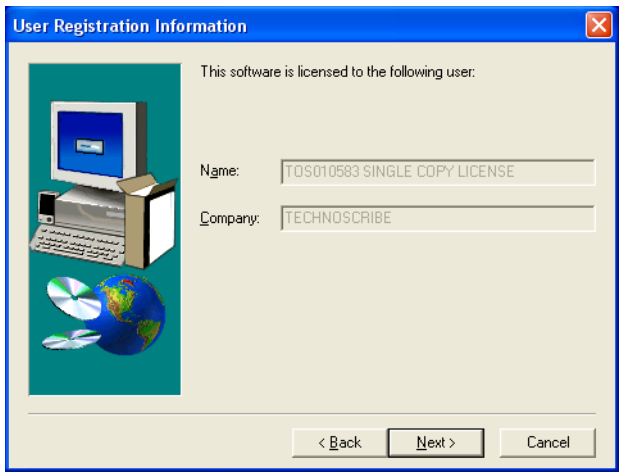

Figure 1.5 User Registration Information

4. Enter *Name* and *Company* and click **Next** and the Setup Type window appears (Figure 1.6).

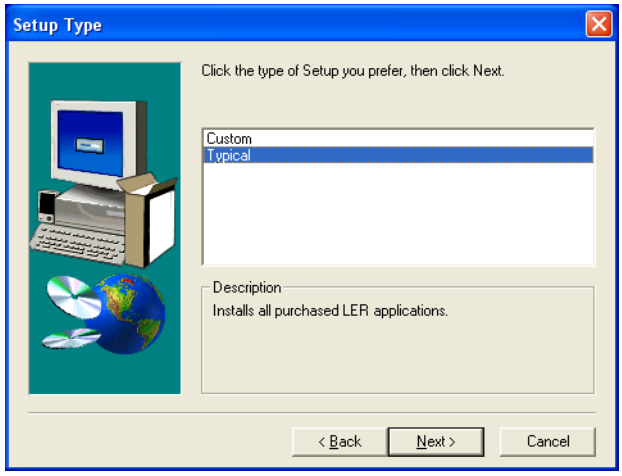

Figure 1.6 Setup Type

5. Click:
   - **Typical** to install all purchased products.
   - **Custom** to select from purchased products.

6. Click **Next** and the Choose Destination Location window appears (Figure 1.7).

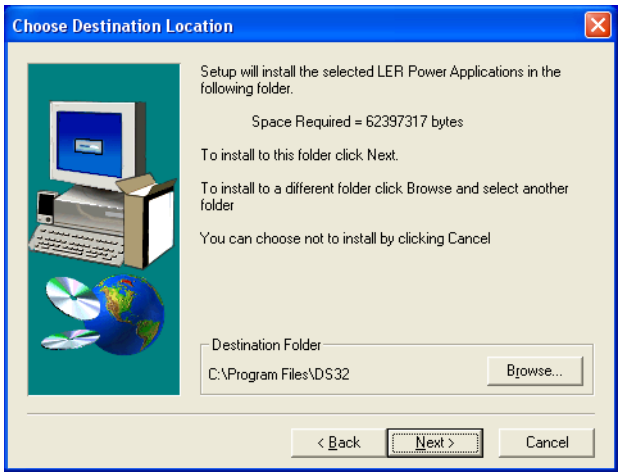

Figure 1.7 Choose Destination Location

The default location for the application is *C:\Program files\DS32* but if DS32 has been previously installed the location of this version is used as the default.

7. Click **Next** and a window to select where database files are stored appears (Figure 1.8).

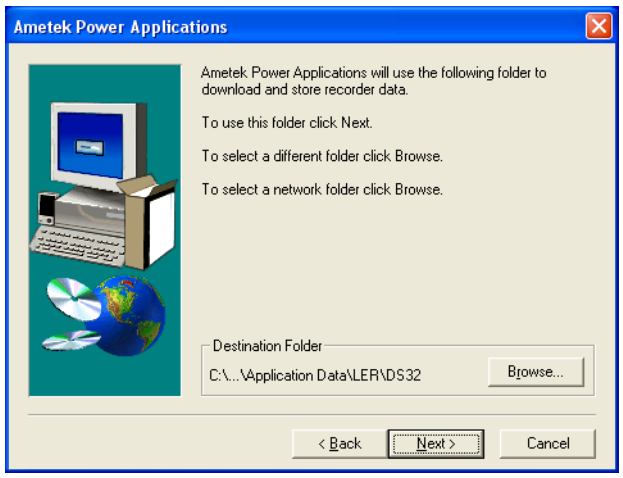

Figure 1.8 Data File Location Selection

The default location of the data files is *C:\Documents and Settings\All Users\Application Data\LER\DS32.* If required the data files can be located on a network drive and shared between multiple versions on DS32. The data files and other parameters are held in a database. In some instances the structure of this database is altered when the software version is updated.

8. Click **Next** and the program begins installation.

A dialog appears asking whether to back up files before install and noting the space required. *This is recommended.*

9. Click **Yes** and then **OK**.

A window appears for you to import data from the 16-bit version of DS (Figure 1.9).

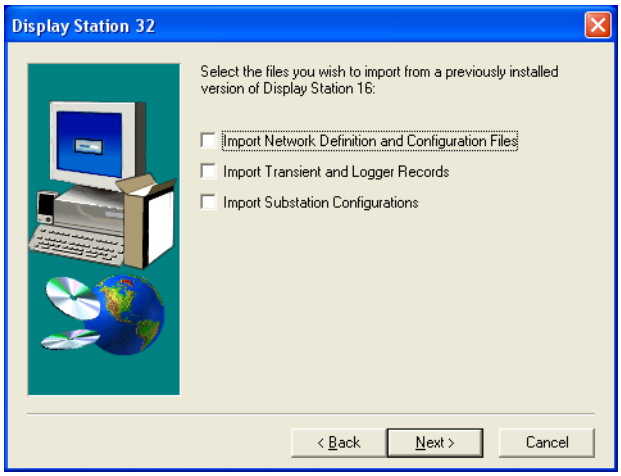

Figure 1.9 Display Station 16-Bit Data Import

10. Click the desired file types and click **Next** and a Setup Complete window appears.

11. Click a radio button to restart the PC now or later to finish the install and click **Finish**.

2. Display Station 32 Software

This chapter explains the Display Station 32 windows, tabs and dialogs and their functionalities. This is accompanied with more detailed descriptions of window/tab/dialog purpose, specific field and button descriptions, and procedures for use, as necessary.

This chapter consists of the following sections:

- ″DS32 Window General Operations″, a discussion of the main window's functions and capabilities.
- ″Main Menu Bar″ on page 2-6, a discussion of the items accessed from the toolbar. General discussions and specific procedures appear.

DS32 Window General Operations

This section consists of the following sections:

- ″DS32 Tabs/Access a Record/Record Dialogs″ on page 2-2
- ″Right-Click Menu″ on page 2-4
- ″Main Toolbar″ on page 2-5

DS32 Tabs/Access a Record/Record Dialogs

There are four tabs used for DS32 operations:

- Transient (Figure 2.1)
- Logger
- Disturbance
- Harmonic

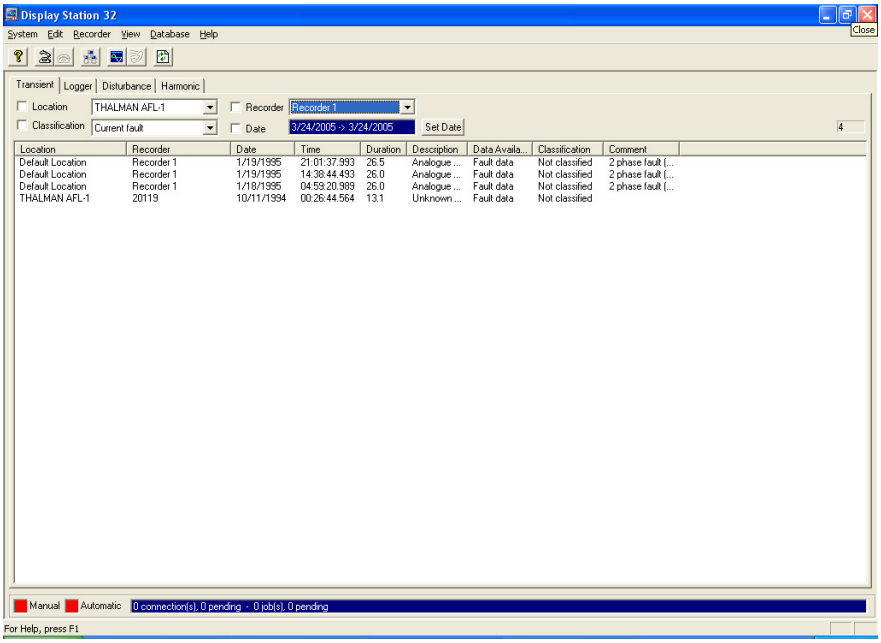

Figure 2.1 Transient Tab

Transient Tab Fields and Buttons

The fields and buttons on the main window tabs perform filtering operations.

Location	Lists the locations available.
Classification	Lists: • *Transient* tab - fault types available • *Disturbance* tab - distinguishes between Classified and Unclassified
Recorder	Lists the recorders available for a particular location.
Set Date	See page 2-10.

Record Dialog Fields and Buttons

The fields on Record dialogs are display only, except for the Comment field.

Comment	Enter a comment to append to the record and click **OK** to save.

The buttons on each Record dialog access some of the DSA32and Expert System tasks associated with each record type.

Analyze fault data	Opens the DSA32 Main Window (Chapter 3 ″Display Station Analysis 32 Menus and Operations″). Transient and Disturbance Record dialogs only.
Analogues	Opens the ″Analogue Profile″ on page 3-41. Transient and Disturbance Record dialogs only.
Digitals	Opens the ″Digital Profile″ on page 3-42. Transient and Disturbance Record dialogs only.
Expert Info	Opens the Transient and Disturbance Record dialogs only.
Expert System	Opens the Expert System Main Window (Appendix A ″Expert System″). Transient and Disturbance Record dialogs only.
Analyze	Opens the Harmonics Display. Logger and Harmonic Record dialogs only.
Transient Events	Active if a PQR logger record contains high speed 1 MHz transient events.

Transient Tab Operations

To perform filtering operations:

- Click a check box and select an item from the drop down. The Locations appearing in the list are actively filtered to reflect your choices.

Figure 2.2 shows the Transient Record dialog as an example.

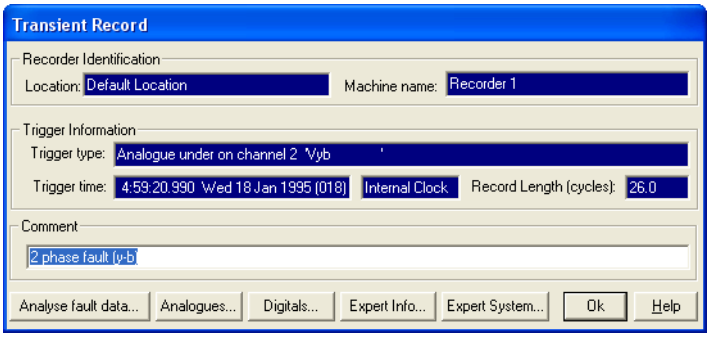

Figure 2.2 Transient Record

To access a record:

1. Double-click on a record.

   The appropriate Record dialog appears (Figure 2.2).

2. Click the button associated with the desired task.

Right-Click Menu

Figure 2.3 shows the DS32 main window tab right-click menu. Except for Analyze cameo data these items are the same as on the bottom or Record dialogs ("DS32 Tabs/Access a Record/Record Dialogs" on page 2-2).

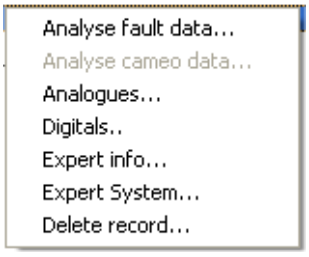

Figure 2.3 Right-Click Menu

Main Toolbar

The main toolbar accesses the following functions listed in Table 2.1.

Table 2.1 DS32 Main Toolbar Icons

Icon	Function
	Recorder Network - Connect ("Connect" on page 2-52)
	Recorder Network Disconnect ("Disconnect" on page 2-54)
	Recorder Network - Edit ("Recorder Network" on page 2-32)
	Recorder Configuration ("Recorder Network" on page 2-32)
	View New Communications Log Entries ("Communications Log" on page 2-160)
	Refresh File List ("Refresh File List" on page 2-6)
	About DS32

Main Menu Bar

The Display Station main menu bar consists of:

- "System Menu"
- "Edit Menu" on page 2-29
- "Recorder Menu" on page 2-51
- "View Menu" on page 2-160
- "Database Menu" on page 2-161
- Help

System Menu

Menu functionalities include: system directory maintenance, communications set up and auto-polling and to implement system security. Menus items include:

- "Refresh File List" on page 2-6
- "Directory Maintenance" on page 2-7
- "Auto-poll & Incoming calls" on page 2-14
- "Auto-poll now" on page 2-17
- "Auto-poll disturbance logger now…." on page 2-18
- "Security" on page 2-19
- "Comms Manager" on page 2-23
- "Data Directory" on page 2-25
- "Options" on page 2-26

Refresh File List

The DS32 database stores the header information for each record in the Display Station 32 data directory. The actual record data are stored in the data directory as files. Each record in the database stores the name of its data file. This function checks all records to ensure their names correspond with the appropriate database records.

CAUTION

Always use Directory maintenance to copy records to and from the data directory to avoid corrupting databases.

Refresh File List Operations

To refresh the file list:

- Select *System* > *Refresh File List* or click  .

Directory Maintenance

The Directory Maintenance window (Figure 2.4) is used to:

- Back up the records in Display Station
- Import previously archived records.
- Analyze previously archived records in DSA32 without importing them into DS32.

The Directory Maintenance - Main Directory window lists all the records currently available in the system, delineating them using the same four tab labels as the Main Directory window. The same filtering used on the Record dialogs ("DS32 Tabs/Access a Record/Record Dialogs" on page 2-2) appears here.

Figure 2.4 through Figure 2.7 show these windows.

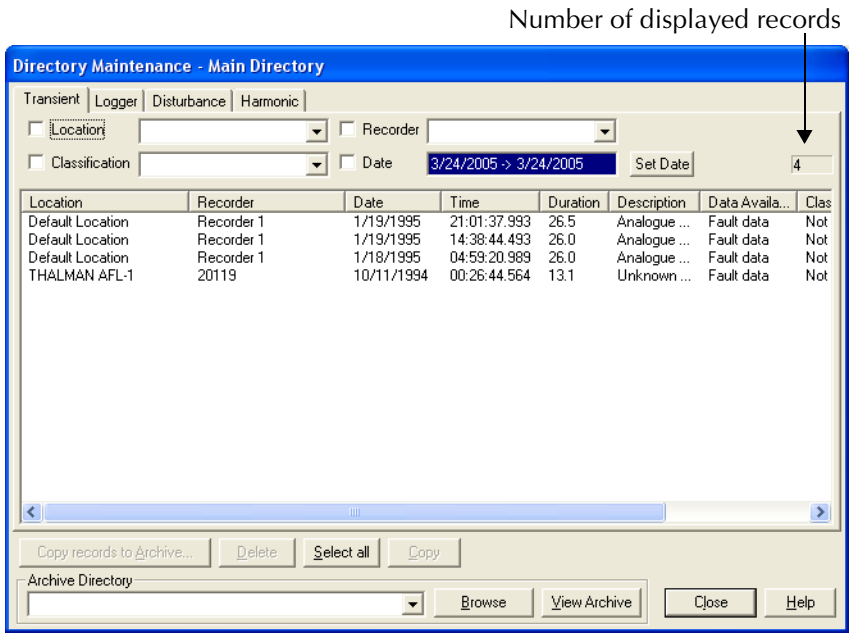

Figure 2.4 Directory Maintenance Window - Transient Tab

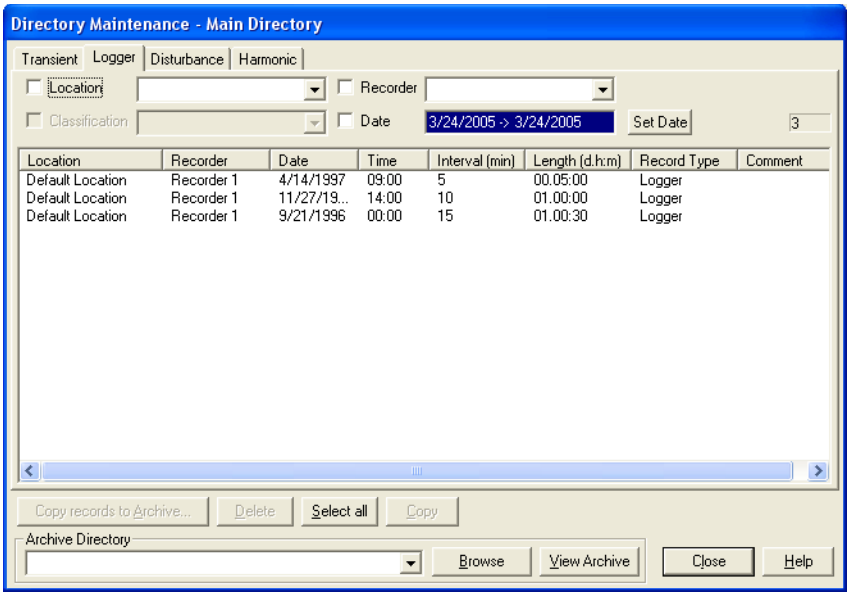

Figure 2.5 Directory Maintenance Window - Logger Tab

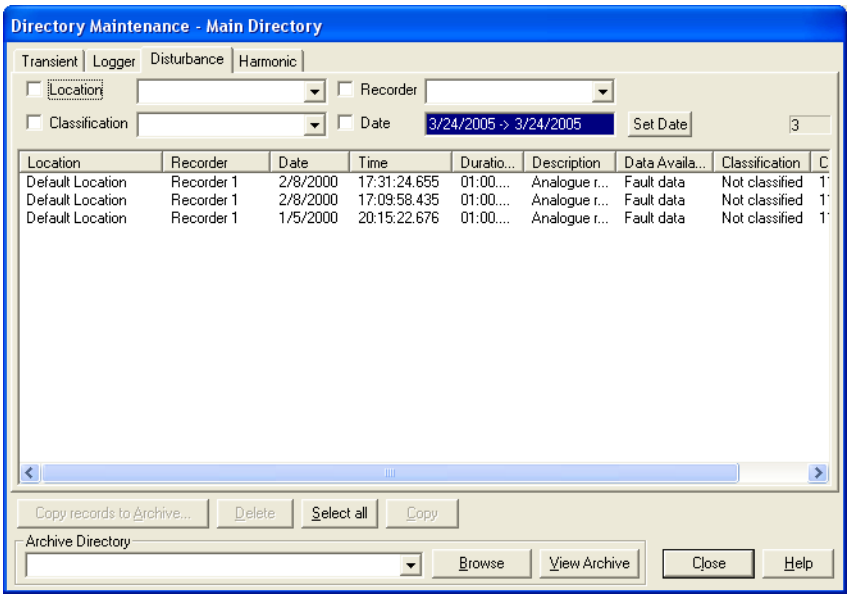

Figure 2.6 Directory Maintenance Window - Disturbance Tab

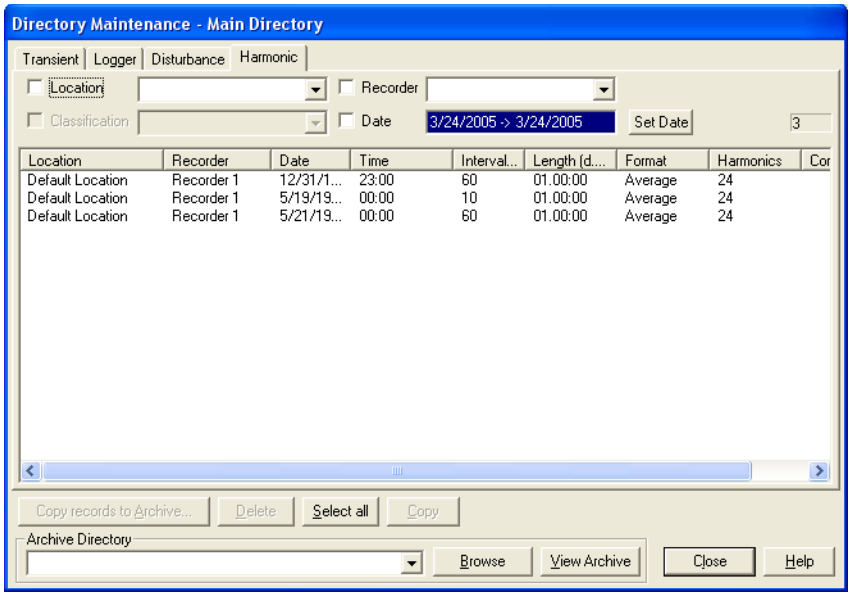

Figure 2.7 Directory Maintenance Window - Harmonic Tab

Fields and Buttons

The fields and buttons on this window tabs perform filtering and archiving operations.

Location — Lists the locations available.

Classification — Lists:

- *Transient* tab - fault types available
- *Disturbance* tab - distinguishes between Classified and Unclassified

Recorder — Lists the recorders available for a particular location.

Set Date — Sets the filtering selections for the records that appear.

Copy records to Archive

Copies records to the archive directory and ensures that duplicate records do not appear in the archive directory. The copied records are not deleted from the directory; use Delete to do this.

Delete — Deletes selected records.

Select All — Selects all the displayed records.

Copy — Copies the selected record entries to the clipboard. From there they can be pasted into a text document (like Word) or spreadsheet (like Excel).

View Archive — Opens the archive shown in the Archive Directory box. From the Directory Maintenance - Archive Directory window, select records from the archive and copy them back to the main directory.

Copy records to Main directory — Copies records to the main directory and ensures that no duplicate records appear in the main directory. The copied records are not deleted from the directory; use Delete to do this.

Analyze — Opens DS32 Analysis to view archived records without importing them to the main directory (See Chapter 3 "Display Station Analysis 32 Menus and Operations").

Directory Maintenance Filtering Operations

To perform general filtering operations:

- Click a check box and select an item from the drop down. The Locations appearing in the list are actively filtered to reflect you choices.

To perform date filtering operations:

1. Click **Set Date** and the Data Filter Selection dialog appears (Figure 2.8).

Figure 2.8 Data Filter Selection

2. Click either radio button:
   - Select a number of days - Select the number of days back from the present.
   - Select specific dates - Select the *From* and *To* dates from the calendars.
3. Click the **Apply Filter to All Lists** check box, if required. This applies the filter to all lists, not just the displayed tab.
4. Click **OK**.

Directory Maintenance Archiving Operations

To copy records to an archive:

1. Select an *Archive Directory* from the drop down or click **Browse** and navigate to an archive.
2. Select a record(s).
3. Click **Copy records to Archive**.

   A dialog appears.
4. Click **Yes**.

To delete a record:

1. Select a record(s).
2. Click **Delete**.

   A dialog appears.
3. Click **Yes**.

   A dialog appears.
4. Click **OK**.

To view archived records:

1. Click **View Archive and the** Directory Maintenance Window - Archive Directory appears (Figure 2.9).

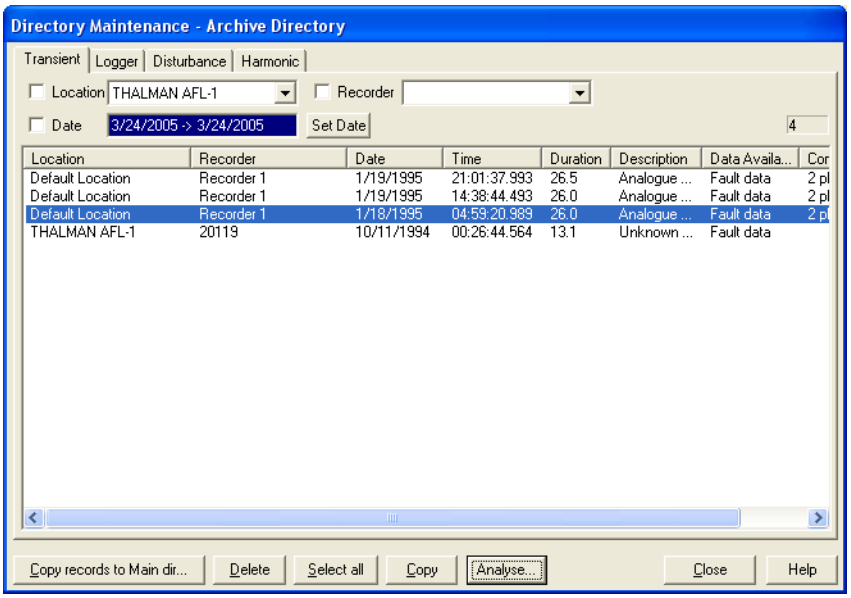

Figure 2.9 Directory Maintenance Window - Archive Directory Tab

2. Select a record(s).
3. Click **Analyze...**

   The Display Station Analysis main window appears.

   For older records:

   The Display Analysis - Classify Phase Groups dialog appears (Figure 2.10).

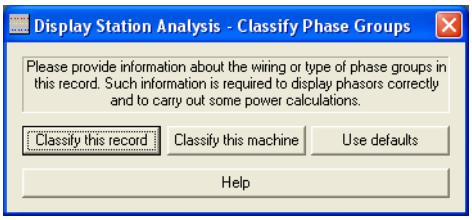

Figure 2.10 Classify Phase Groups I

a. Click the appropriate button:

- **Classify this record**
- **Classify this machine**
- **Use defaults**

The Display Station Analysis Classify - Phase Group dialog appears (Figure 2.11) for the first two bullets.

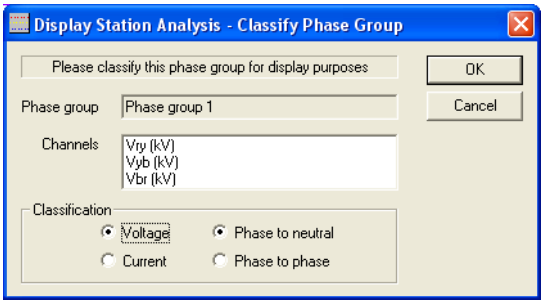

Figure 2.11 Classify Phase Groups II

b. Select a *Channels* and a *Classification* for a Phase group and click **OK**.

This repeats until all Phase groups are configured. The Display Station Analysis appears ready for use.

The Harmonics Display or DSA appears.

To copy records to the main directory:

1. Select a record(s).
2. Click **Copy records to Main dir**.

   A dialog appears.
3. Click **Yes**.

   A dialog appears.
4. Click **OK**.

Auto-poll & Incoming calls

Use this window (Figure 2.12) to automatically contact any or all of the recorders in the network at a particular time on a selected day of the week. Any new profiles or complete data records are then automatically transferred to Display Station.

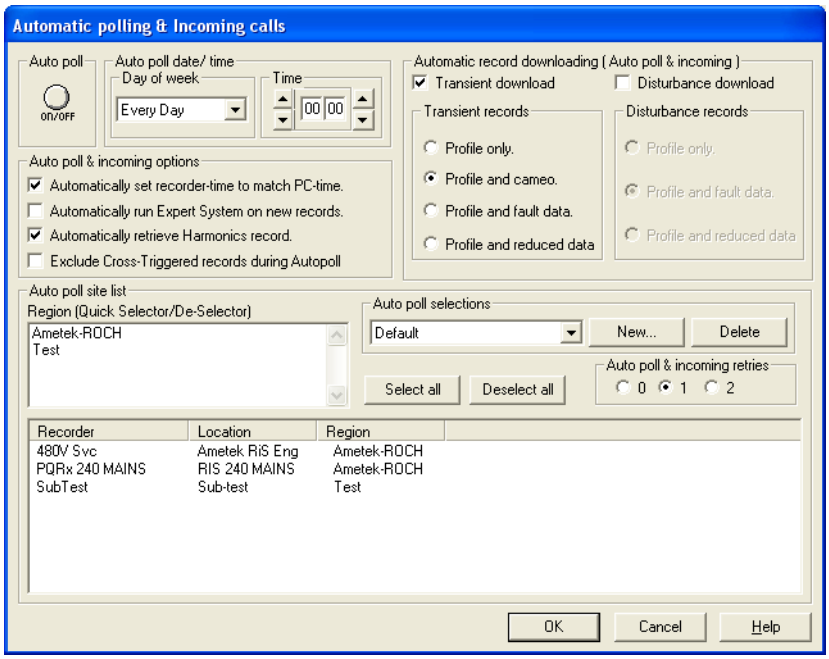

Figure 2.12 Auto-poll & Incoming calls

Buttons and Fields

Auto-poll — Enable this and auto-poll downloads Transient, Disturbance and Harmonic records according to the criteria specified on the window.

Auto-poll date/time — Sets the day and time. Normally the best times to do auto-polling are late at night or early in the morning, as the cost of the calls are reduced and data transfers do not interfere with normal daytime telephone traffic or corporate LAN traffic.

If auto-poll is required more often, set it to start at the time set by the Time selection every day and repeat every 2, 4, 6 or 12 hours from the top of the list.

Automatic record downloading (Auto-poll & incoming)

Transient download/Disturbance download

Select a check box to activate the record types to download during an auto-poll connection. Activates the associated profile radio buttons for use.

Profile radio buttons Indicate the type of data to download. Profile choices include:

- *Profile only* - downloads only profile data.
- *Profile and cameo* - download profile and cameo data. Transient records only.
- *Profile and fault data* - downloads both profile and fault data.
- *Profile and reduced data* - downloads the selected channels, sample rates and times set for each individual recorder. To set these, see "Configure - Configure a Recorder" on page 2-54. Reduced data is available on a TR2000 or TR100+.

Retries Sets the number of times auto-poll tries to contact a recorder: 0,1 or 2.

Auto-poll site list Select the recorders to auto-poll.

Auto-poll selections

Lists the Default list and lists you create. Created lists can have different polling times, flags and recorders. The Auto poll on/off button enables only the list selected. However, multiple lists can be active at anytime. All selections are automatically saved when the selection in this pull down is changed.

New Adds a new Auto poll list.

Delete Click to delete a list select the name from the drop down.

Auto-poll and Incoming options

Automatically set recorder time to match PC time - updates the time on each recorder polled to the time on the polling PC.

Automatically run Expert system on new records - runs the Expert System after auto-polling. This classifies all the records downloaded and stores the results. See Appendix A ″Expert System″.

Automatically retrieve harmonic records - downloads harmonic logger records while auto-polling. The logger interval is set for each recorder in the ″Harmonics Configuration – TR100″ on page 2-60 or ″Harmonics Configuration – TR2000, TR100+ & PQR″ on page 2-61. Other logger records are not recovered automatically.

Exclude Cross-Triggered records during Auto-poll - ignores all cross triggered records. This can be useful at locations where there are many cross triggered recorders to reduce the volume of polled data.

Automatic Polling & Incoming Calls Operations

Automatic polling & Incoming calls procedures

To configure this window:

1. Select a list from *Auto poll selections*.
2. Click Auto poll **on/off**.
3. Select *Auto poll site list Regions* or *Recorders*:
   - Select a recorder and that recorder is selected. The Region is also selected, but not all recorders in the Region.
   - Select a region and all recorders in the Region are selected.
4. Configure:
   - *Auto poll & incoming options*
   - *Automatic record downloading options*
   - *Auto poll date/ time options*
5. Click **OK**.

To add a new Auto poll selections list:

1. Click **New** and Figure 2.13 appears.

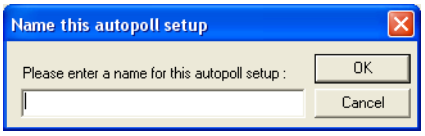

Figure 2.13 Name this autpoll setup

2. Enter a unique list name.
3. Click **OK**.

Auto-poll now

Use this window (Figure 2.14) to force the system to do an auto-poll immediately. The Auto-poll/call and Auto-poll now windows are almost identical, the difference being that Auto-poll now does not have the date/time facility.

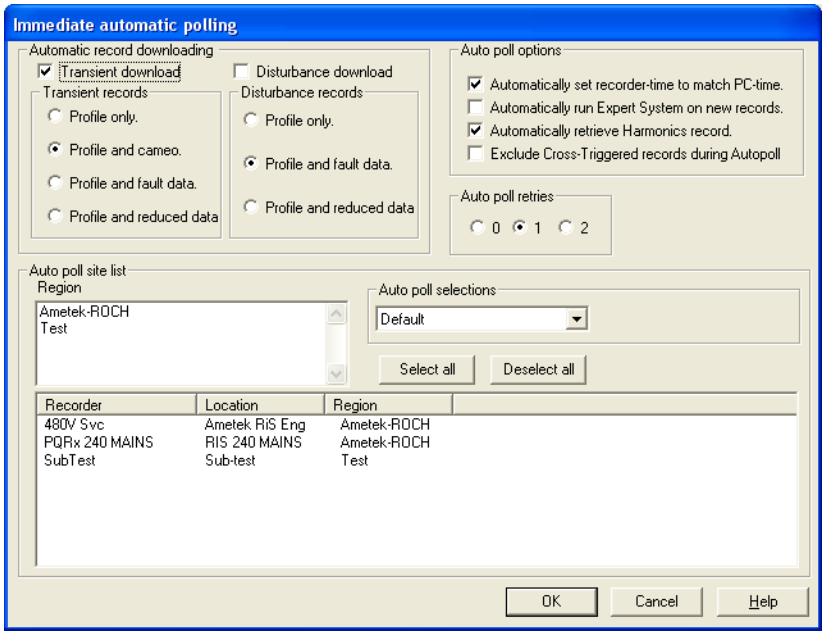

Figure 2.14 Immediate Automatic Polling

Buttons and Fields

See Buttons and Fields in "Auto-poll disturbance logger now…." on page 2-18

Immediate Automatic Polling Operations

Immediate automatic polling procedures

To configure this window:

1. Select a list from *Auto poll selections*.
2. Click Auto poll **on/off**.
3. Select *Auto poll site list Regions* or *Recorders*:
   - Select a recorder and that recorder is selected. The Region is also selected, but not all recorders in the Region.
   - Select a region and all recorders in the Region are selected.
4. Configure:
   - *Auto poll & incoming options*
   - *Automatic record downloading options*
   - *Auto poll date/ time options*
5. Click **OK**.

Auto-poll disturbance logger now….

Use this window (Figure 2.15) to allow the continuous disturbance logger data to be recovered from a number of recorders.

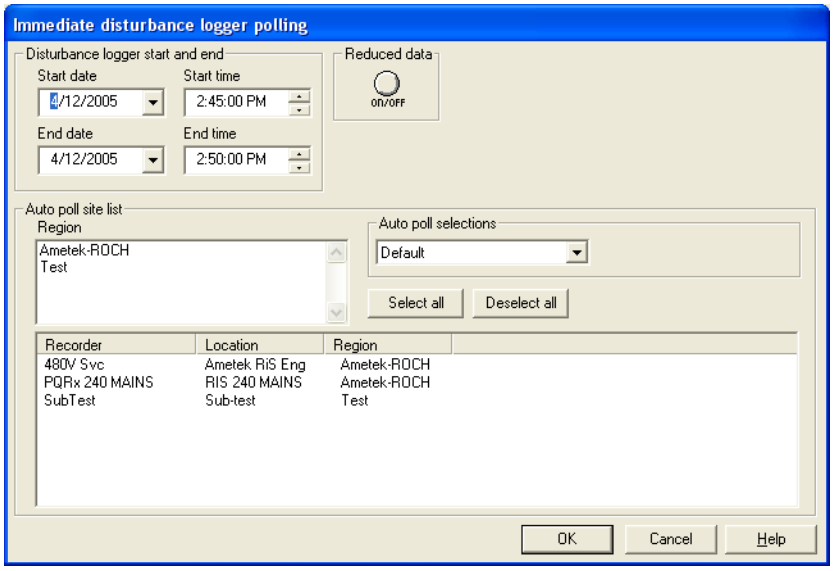

Figure 2.15 Immediate Disturbance Logger Polling

Buttons and Fields

Reduced data Enables the download of only reduced data.

Disturbance Logger Start and End

Set the Start and End Date/Time for the disturbance logger data required. If logger data is not available for the date and time entered here then nothing is downloaded. Disturbance logger data is available for the previous two weeks.

Auto-poll site list

Select the recorders for auto-poll.

Auto-poll Selections

Select a list of recorders to poll. This list is set up using the"Auto-poll & Incoming calls" on page 2-14.

Immediate Disturbance Logger Polling Operations

Immediate disturbance logger polling procedures

To configure this window:

1. Select a list from *Auto poll selections*.
2. Click Reduced data **on/off**, if required.
3. Select *Auto poll site list Regions* or *Recorders*:
   - Select a recorder and that recorder is selected. The Region is also selected, but not all recorders in the Region.
   - Select a region and all recorders in the Region are selected.
4. Click **OK**.

Security

The Security menu consists of the operations consist of:

- *Unlock* - Use this option to unlock Display Station 32. This changes the security level to 1 or 2; whichever was last set.
- *Lock* - Use this option to lock Display Station 32, i.e. to set its security level to 0.
- *Change Keys* - Changes the security keys.
- *Import Recorder Passwords* - Imports recorder passwords.
- *Export Recorder Passwords* - Exports recorder passwords.

There are three security levels in Display Station 32, level 2, level 1 and level 0. The level allow the following access to program functionality:

- *Level 2* - Top level access (default), you can download data, change recorder configurations and delete records.
- *Level 1* - Medium access, you can connect to recorders and download data but cannot change recorder configurations or delete records.
- *Level 0* - Restricted access, you can view data currently on the PC, but cannot connect to recorders or change configurations or delete records.

NOTE

If auto-poll has been configured using Level 2 and the security is changed to level 0, Auto-poll still operates. Auto-poll Now requires Level 1 security.

Buttons and Fields

Security Key Level 1

Changes the key used for accessing Security Level 1. If the level 1 security key has not been set before then Old is disabled.

Security Key Level 2

Changes the key used for accessing Security Level 2. If the level 2 security key has not been set before then Old is disabled.

Security Operations

Change security keys

To change security keys:

1. Select *System* > *Security* > *Change Keys* and the Change security keys dialog appears (Figure 2.16).

Figure 2.16 Change Security Keys

2. Click the **Change** check box for each Security Key Level, if required.
3. Enter a password the *New* and *Confirm* fields.

NOTE

Enter a different password for each Security Key Level.

4. Click **OK**.

Security Unlock/Lock

To unlock/lock:

1. Select *System* > *Security* > *Unlock* and the Enter Security Access Key dialog appears (Figure 2.17).

Figure 2.17 Enter Security Access Key

2. Enter the password here of the security level desired.
3. Click **OK**.

   A dialog appears informing you of the security level in force.

To set the security level back to zero:

- Select *System* > *Security* > *Lock*.

Import/Export Recorder Password operations

To import or export recorder passwords:

1. Select the appropriate menu item and a dialog box appears (Figure 2.18 or Figure 2.19).

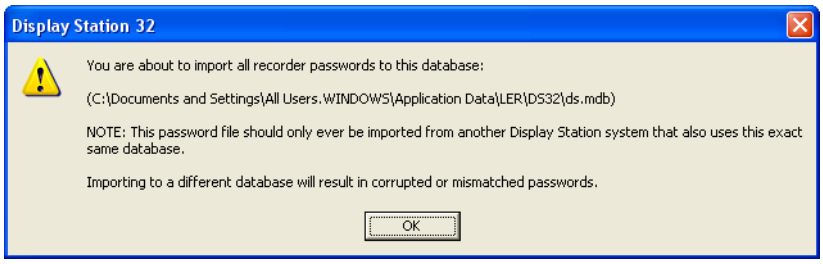

Figure 2.18 Import recorder passwords

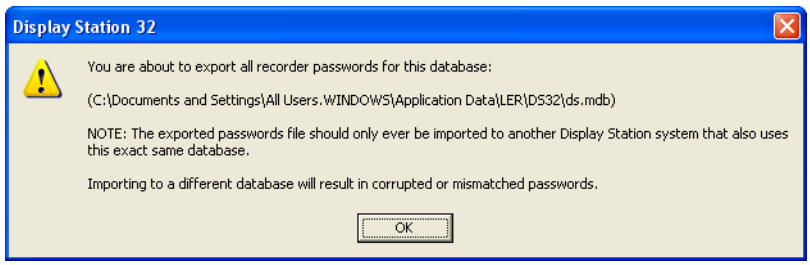

Figure 2.19 Export recorder passwords

2. Click **OK**.

   An Open, for Import, or Save As dialog (for Export) appears.

3. Select the desired directory and click **Save** or **Open**.

Comms Manager

From version 2.0 of DS32 onwards Windows-configured modems can be used for recorders connections. The actual procedure used depends on the operating system (2000, XP) (see "Windows 2000 Configuration" on page B-3).

If:

- Dial up networks or pseudo machines are used, then dial out and dial in connections must be configured, see "Windows 2000 Configuration" on page B-3.
- 3Com 56k LAN modem are used for dial-up networking, see Appendix B "3Com 56k LAN Modem Configuration: Manual and Autopolling".
- 3Com LAN modem is to be used for Auto-poll, see "3Com 56k LAN Modem Configuration: Manual and Autopolling" on page B-1.

Figure 2.20 shows the Comms Manager.

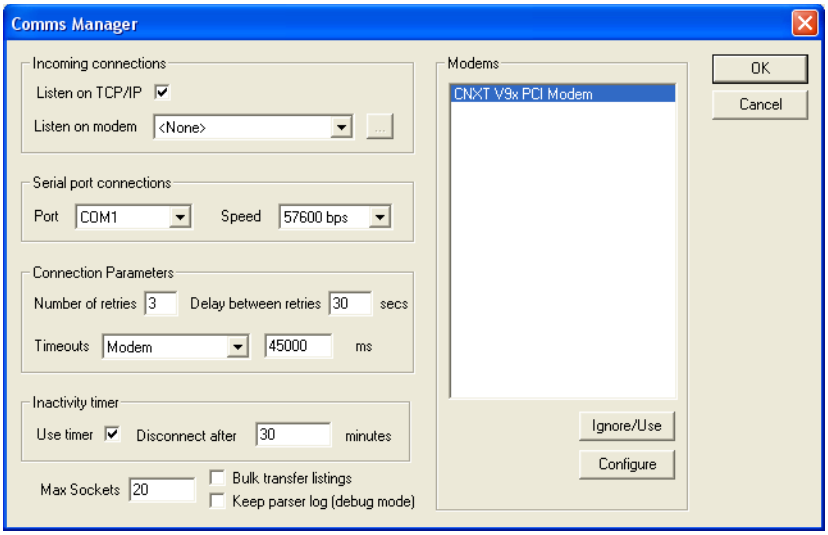

Figure 2.20 Comms Manager

Button and Fields

Incoming connections

Use both network and modem connections if auto-call is used. Select the Listen on TCP/IP check box for LAN/WAN or dial-up networking. Select the modem for use for auto-call connections for direct modem connections.

Serial port connections

Sets the COM port for direct serial connections to a recorder and the baud rate. The default baud rate for a TR2000, TR100+ and PQR is 57600 bps. The default baud rate for a TR100 is 19200 bps.

Connection Parameters

Sets the number of connection retries and retry delays for modem and network connections. For each connection type a different Timeout can be set. For most types the default is 4500 msec.

Inactivity timer Sets an inactivity timeout for any connection. This is the amount of time with no data being sent in either direction before the connection is dropped.

Max sockets Sets the maximum number of available sockets for network connections. This limits the maximum concurrent network connections. The default value is 20.

Keep parser log Saves all the recorder commands in a parser log file before testing. Do not use this during normal operation.

Bulk transfer listings Activate to retrieve directory listings using a more robust method that takes longer. Use this option for noisy lines where problems occur getting directory listings.

Modems Lists all the modems available for use.

Ignore/Use Click to ignore a selected modem. IGNORE appears next to the modem name.

Configure Use to check or change the configuration of a modem.

Comms Manager Operations

To configure communications:

1. Select *System > Comms Manager* and the Comms Manager appears (Figure 2.20).
2. Click the **Listen on TCP/IP** check box for LAN/WAN or dial-up networking.
3. Select the modem for use from the *Listen* on modem drop down.
4. Click the browse button next to *Listen* on modem to configure the modem, if required.
5. Select an available com port from the *Port* drop down for direct serial connections to a recorder.
6. Select the baud rate from the *Speed* drop down.
7. Enter the *Number of retries* and the *Delay between retries*.
8. Select the connection type using the *Timeouts* and enter the timeout.
9. Click the **Use timer** check box and enter a *Disconnect after time*, if required.
10. Enter the *Max sockets*.
11. Click **Bulk transfer listings** and **Keep parser log** check boxes, if required.
12. Click **OK** and a dialog appears.
13. Click **OK** and restart for changes to take effect.

Data Directory

Displays the directory (Figure 2.21), set up during installation, where the database is stored and where the fault records are downloaded. The data directory can reside on the local machine or on a network file server.

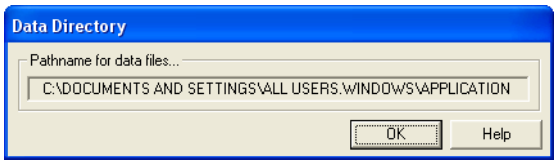

Figure 2.21 Data Directory

NOTE

The data directory is defined when the application is installed and cannot be changed by DS32

Options

Two functions are configured using Options (Figure 2.22):

- Whether the directory entries are refreshed when Display Station is started.
- Determining if transient records and/or disturbance records are recovered manually or automatically for automatic export in COMTRADE format. This is useful if another analysis or display application is being used. The COMTRADE files conform to the 1999 standard.

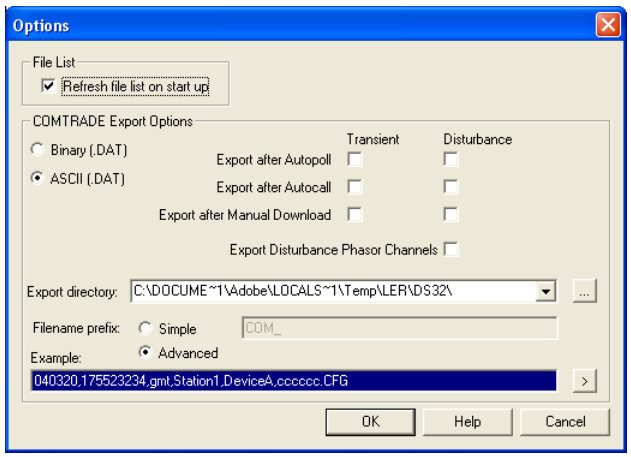

Figure 2.22 Options

Figure 2.23 shows the Options Advanced - Export File Prefix window.

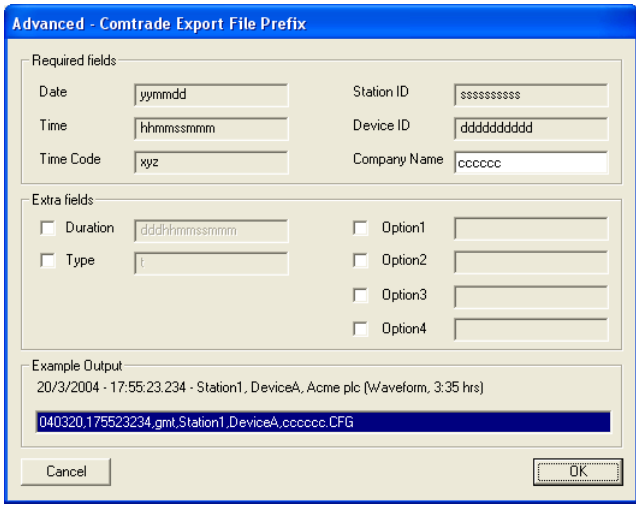

Figure 2.23 Advanced - Comtrade Export File Prefix

Buttons and Fields

Refresh file list on start up

Click to refresh the file list on startup. If the number of records is large it may be better to leave this switched off. The file list can be refreshed manually by using the Refresh file list on the System menu.

COMTRADE Export Options

Export after Autopoll/Export after Autopoll/

Export after Manual Download

Automates the export of transient/disturbance records using the check boxes.

Export Disturbance Phasor Channels

Automates this export with COMTRADE export.

Binary/ASCII Select the data file format radio button.

Export Directory Select the destination directory.

Filename prefix Select either the:

- Simple radio button to enter a prefix.
- Advanced radio button to use the Advanced window. You can choose a file naming convention that uses details of the actual record itself for the filename.

COMTRADE Export - Advanced File Naming

Use this window to set up different options for file naming of exported COMTRADE records. The filename must firstly be represented by:

Date, Time, Time Code, Station ID, Device ID

Automatically populated by DS32.

Company Name Enter a name.

Additional filename parts can be selected from the following list:

- *Duration* - Click the check box to append this to the file name.
- *Type* - Click the check box to append this to the file name.
- *Option1 ...4* - Click the check box to append text.

An example exported file is:

050202,142116261,UT,LocationB,A Machine,AmetekPI,000000000210,wave,opt1.cfg
This represents file created at date 2nd Feb 2005, time 14:21:16.261, Universal Time, LocationB, Machine A.
Company name is AmetekPI, and the record duration was 210 mSecs.
It is a waveform file and one option (opt1) was included.

Options Operations

To configure Options:

1. Select *System* > *Options* and the Options window appears (Figure 2.22 on page 2-26).
2. Click the **Refresh file list on start up** check box, if required.
3. Click the **Binary** or **ASCII** radio button.
4. Click any **Export** check boxes, as required.
5. Click the browse button and use the Browse for Folder dialog to navigate to and select a folder, as required.
6. Configure Filename prefix by clicking the radio button for either:
   - **Simple** and entering a file name in the field.

   or

   - **Advanced** and clicking **>** to open the Advanced window (Figure 2.23 on page 2-26) and:
     a. Enter a *Company Name*.
     b. Click the **Duration** and **Type** check boxes, as required.
     c. Click an **Option** check box(es) and enter text, as required.
     d. Click **OK**.

   The Options window reappears.
7. Click **OK**.

Edit Menu

There menu options available are:

- ″Delete″
- ″Copy″
- ″Paste comment″
- ″Select All″
- ″Import COMTRADE″
- ″Export COMTRADE″
- ″Recorder Network″
- ″Communications Status″

Delete

Deletes records from the main window's list of records. Security level 2 is required.

Record Delete Operations

To delete a record:

1. Select a record.
2. Select *Edit > Delete* or press the *<Delete>* key.

Copy

Copies the directory entries for all the selected records to the clipboard.

Record Copy Operations

To copy a record(s):

1. Select a record(s).
2. Select *Edit > Copy* or press the keyboard *Ctrl-C*.
3. Copy into any word processor.

Paste comment

Use this to add the same comment to a number of records simultaneously. This could be used for records with the same source such as voltage dips and loss of supply.

Record Past Comment Operations

To paste a comment:

1. Select a record(s).
2. Select *Edit > Paste comment* and the Paste comment to selected records dialog appears (Figure 2.24).

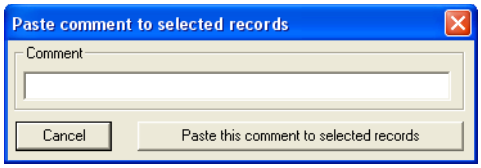

Figure 2.24 Paste comment to selected records

3. Enter a comment and click **Paste this comment to selected records**.

   A dialog appears.

4. Click **Yes**.

Select All

Selects all the records in the main window.

Import COMTRADE

Opens COMTRADE files for viewing in Display Station and Display Station Analysis.

Import Comtrade Operations

To import a COMTRADE file:

1. Select *Edit > Import COMTRADE...*

   The Open dialog appears (Figure 2.25).

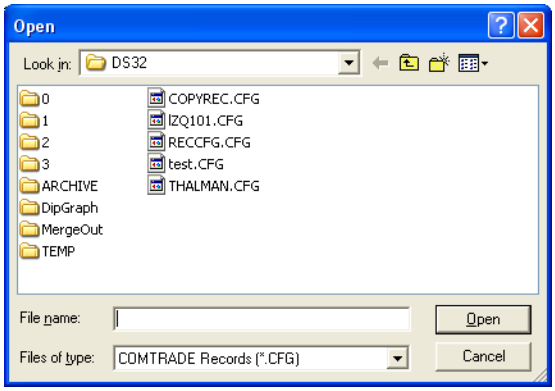

Figure 2.25 Import Comtrade Selection

2. Navigate to the desired directory and select the .cfg file.
3. Click **Open**.

The Comtrade Record window appears (Figure 2.26).

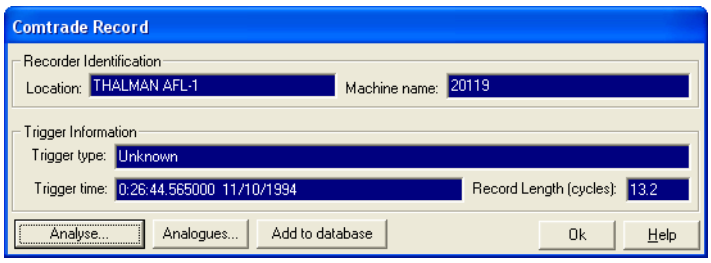

Figure 2.26 Comtrade Record

4. Click:
   - **Analyze** - Open DSA for that record.
   - **Analogues** - Opens the Analogue fault level - RMS dialog ("Analogue Profile" on page 3-41) if the file has profile data.
   - **Add to database** - Adds the record to the DS database.
   - **OK** - Closes the dialog with no import.

Export COMTRADE

Use this window (Figure 2.27) to export Display Station 32 records in COMTRADE Format.

Export Comtrade Operations

To export a COMTRADE file:

1. Select a location in the Display Station 32 window
2. Select *Edit > Export COMTRADE.*

   The Export Comtrade dialog appears (Figure 2.27).

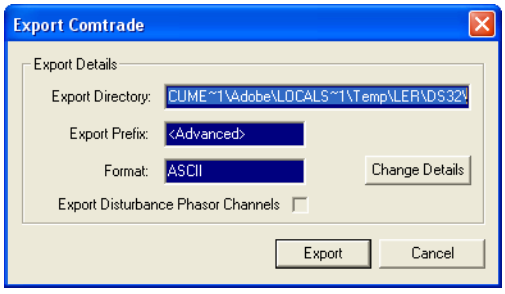

Figure 2.27 Export Comtrade

The dialog fields appear populated. If changes are required:

a. Click **Change Details**.

The Options dialog appears ("Options" on page 2-26).

b. Change the *Export Directory, Prefix, Export options* or the *Format,* as required.

c. Click **OK**.

The Export Comtrade dialog reappears.

3. Click **Export**.

Recorder Network

Display Station 32 stores a list of all the recorders to which it can connect, as well as the connection information for each recorder. The Recorder Network - Edit window is used to enter and edit this information.

Select *Edit > Recorder Network* and the Recorder Network - Edit window appears (Figure 2.28). This lists all the recorders in the network and uses a *tree* control very similar to Windows.

The recorder hierarchy is:

- *World* - All recorders belong to the Recorder Network shown as the *world* symbol at the top of the tree.
- *Region* - Each region is used to group a number of locations. Recorders without a region are all listed under No Region Specified.
- *Location* - Each location is used to group a number of recorders. This aids easier selection from a larger number of recorders.

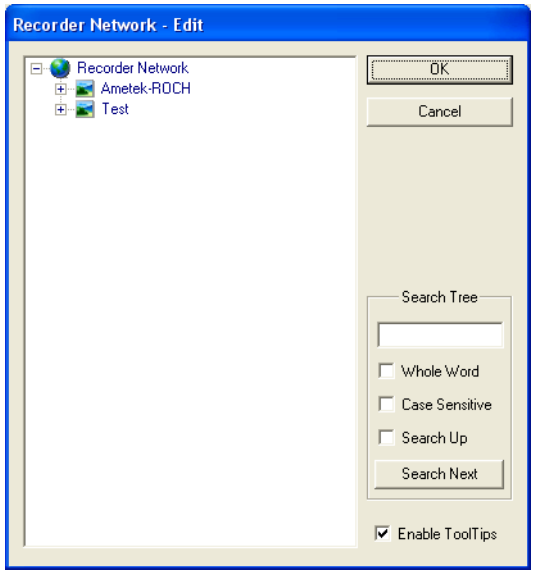

Figure 2.28 Recorder Network - Edit

Button and Fields

Search Tree

Searches the recorder network to find a particular region, location or recorder. This is very useful if there are a large number of recorders in the network. Check the relevant box to enable other options:

Whole word — Ensures that a word must match completely in a search. The default is that partial matches can be found.

Case sensitive — Activates case sensitivity for the search.

Search up — Makes the search go up the tree. The normal search order is top down.

Enable ToolTips — Enables the display of information about an object when the cursor moves over its name.

Recorder Network - Edit Operations

Right-click on the machine and select Edit Recorder Details (Figure 2.29).

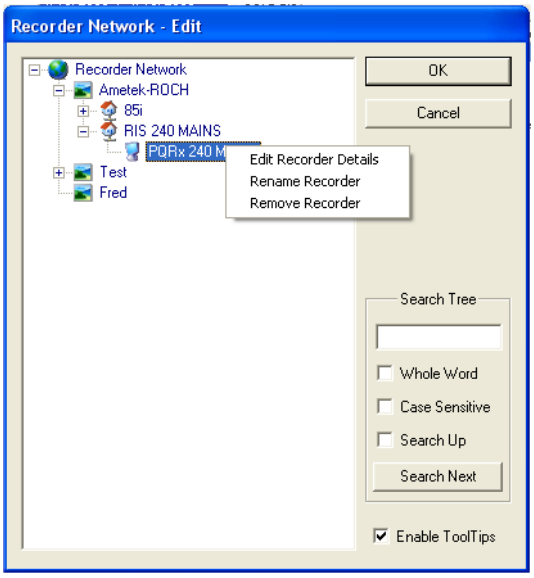

Figure 2.29 Recorder Network - Recorder Details

Perform A Recorder Search

To perform a recorder search:

1. Enter the name in the text box. If the full name is not known use a partial entry.
2. Click the appropriate search criteria check boxes.
3. Click **Search Next.**

   If an item is found it is highlighted.

Add a Region

To create a new region:

1. Select *Edit > Recorder Network* and the window appears (Figure 2.28).
2. Select *Add Region* (Figure 2.30).

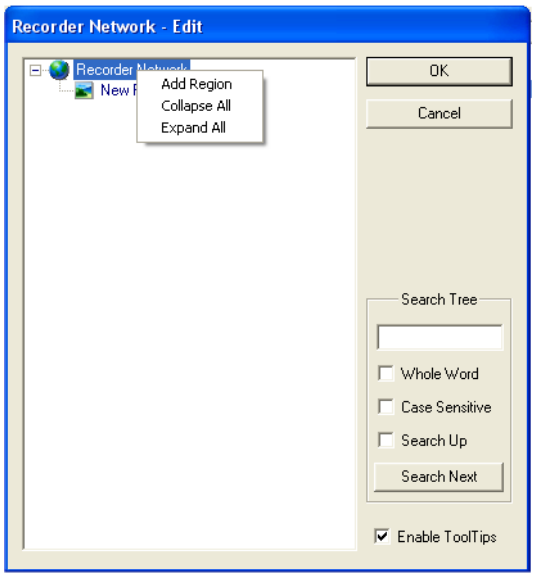

Figure 2.30 Recorder Network - Add Region

A New Region line appears (Figure 2.31).

3. Right-click on *New Region* and select *Rename Region*.

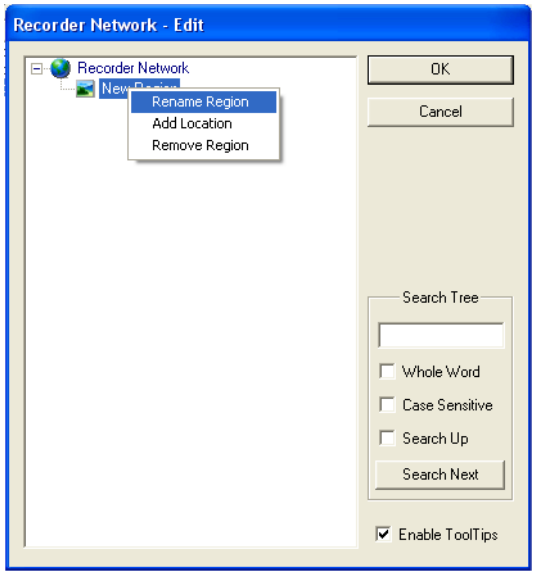

Figure 2.31 Recorder Network - Rename Region

The New region text is now editable.

4. Enter a name of up to 24 characters to uniquely identify the region and click in the window area.

To Remove a Region:

1. Select *Remove region* and a warning message appears (Figure 2.32).

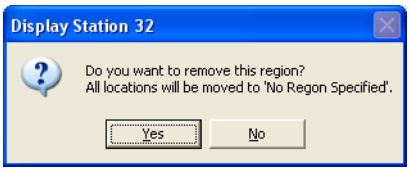

Figure 2.32 Remove Region Warning

2. Click **Yes**.

   Any locations at the deleted region are moved to the No Region Specified region.

Add a Location

To add a location:

1. Right-click on the renamed *Region* and select *Add Location*.

   The location appears as New Location (Figure 2.33).

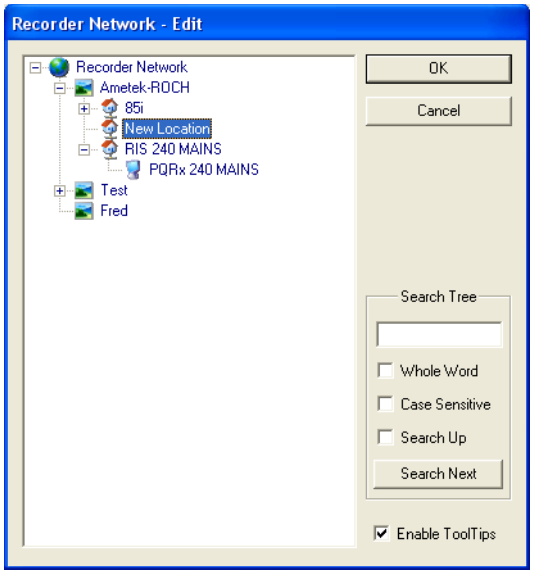

Figure 2.33 Recorder Network - Add Location

2. Right-click and select *Rename Location*.

   The text is now editable.

3. Enter a name of up to 24 characters to uniquely identify the location and click in the window area.

NOTE

Once created, locations can be dragged into other regions.

Remove a Location:

To remove a location:

1. Select *Remove location* and a warning message appears (Figure 2.32).

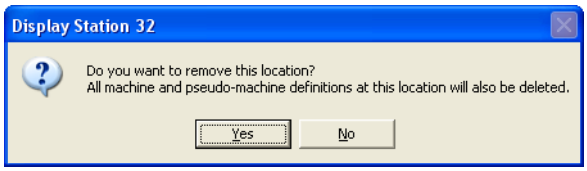

Figure 2.34 Remove Location Warning

2. Click **Yes**.

   Any machines and pseudo machines for the location are removed. For details on the Pseudo Machine see "Pseudo Machine" on page 2-46.

Add a Recorder

To create a new recorder:

1. Right-click on the location and select *Add Machine*.

   A default Machine line appears (Figure 2.35).

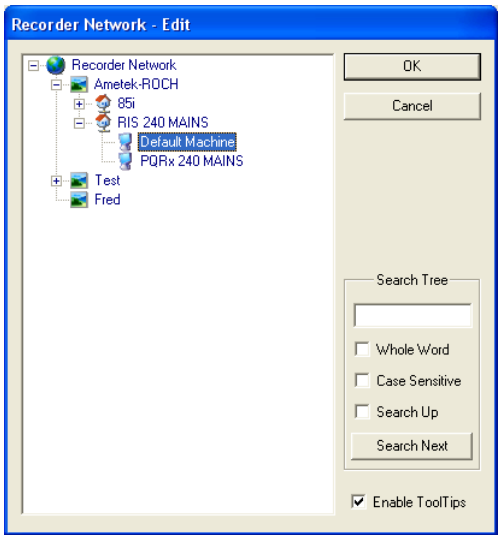

Figure 2.35 Recorder Network - Add Machine

2. Right-click and select *Rename Location*.

   The text is now editable.

3. Enter a name of up to 24 characters to uniquely identify the recorder and click in the window area.

Remove a recorder

To remove a recorder:

1. Select *Remove recorder* and a warning message appears.
2. Click **Yes** and all recorder details are deleted.

Edit recorder details

Modem Tab

Figure 2.36 shows the Modem tab.

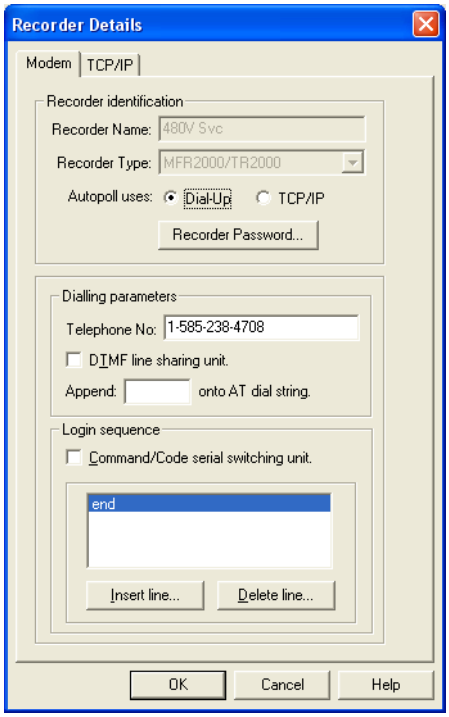

Figure 2.36 Recorder Details - Modem Tab

Buttons and Fields

Recorder Name	Display only.
Recorder Type	Select the recorder type from TR2000, TR100, TR100+ or PQR. Aides in the creation of the recorder configuration before a connection has been made.
Auto-poll uses	Select the preferred mechanism for auto-poll for recorders with two types of remote connection. In later versions of Display Station 32, both these types are available if the recorder has support for both peripherals.
Recorder Password	Opens the Recorder Password dialog to add password security for the recorder.

Dialing parameters Enter the phone number for the substation including all the required access and area codes. If a DTMF line sharing unit is used to route calls at a location to the recorder, for best results make the two appended digits different.

Login sequence Some forms of code operated switch require a sequence of commands and responses after a modem call is answered and before a recorder connection is made. This sequence can be automated using a series of commands. Three types of command are supported:

- *Waitfor* - Wait for the defined string with a time-out
- *Delay* - Wait for the defined number of seconds
- *Send* - Send the defined string

Based on these commands a log on script can be created which supports most switches. An example script for an RFL switch is:

```
waitfor 30 "access."
delay 1
send "^M"
waitfor 30 "word:"
send "LER^M"
waitfor 30 "MOTE>"
send "2^M"
delay 2
end
```

The ^M sequence represents a carriage return which is equivalent to holding down the Ctrl key and pressing M on a keyboard. Other control characters are created in this way.

Command/Code serial switching unit

Click the check box to activate this and the Login Sequence added using Insert Line.

Insert Line Opens the Insert Login dialog to add a sequence for a serial code switch unit to connect to the recorder.

TCP/IP Tab

Figure 2.37 shows the TCP/IP tab.

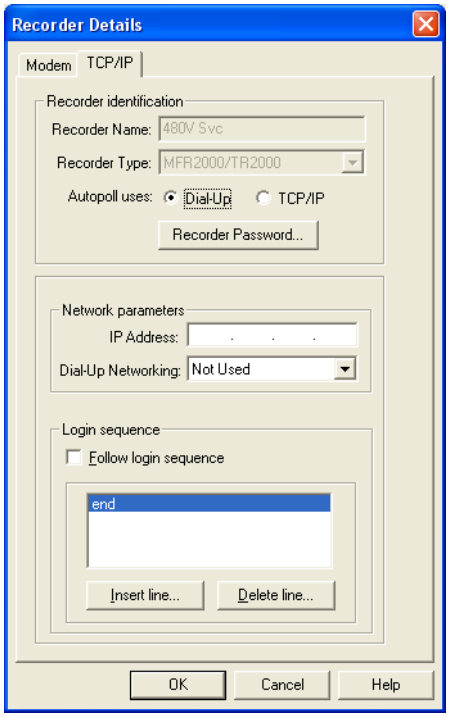

Figure 2.37 Recorder Details - TCP/IP Tab

Buttons and Fields

Recorder Password See "Modem Tab" on page 2-39.

Network parameters – IP address

Enter a unique IP address. The IP address is a unique 12-digit number that must be entered in the form:

123.156.189.012

Each group of 3 digits can have a value from 0 – 255. This address must be the same as that in the recorder configuration network definition. A subnet mask and router address can be entered in the network set up of the recorder configuration.

Within a network or intranet IP addresses are normally issued by a system administrator or IT department. An IP address should not be assigned without consulting the relevant authority.

Network parameters – Dial Up Networking

Select from the drop down, which also requires that a recorder IP address is entered. There is an option to connect to a remote recorder (or recorders) linked to a network using Windows Dial Up Networking. If this is required, the connection set up the connection in Windows before entering the recorders into the Recorder Network. For details on setting up Dial Up networking see Appendix B ″3Com 56k LAN Modem Configuration: Manual and Autopolling″ and Appendix C ″DS32 3Com/Remote TR 3Com LAN Modem Connection Configuration (Autocall)″.

Login sequence

Click **Follow login sequence** to activate. If there is a firewall in the router to access individual recorders a logon script can be created to automatically issue the correct commands and connect to the recorder.

If a User name and Password are required for Dial up Networking, enter them as part of the connection set up in Windows.

Recorder Details Operations

To edit recorder details:

1. Right-click on a recorder and the Recorder details window appears (Figure 2.38).

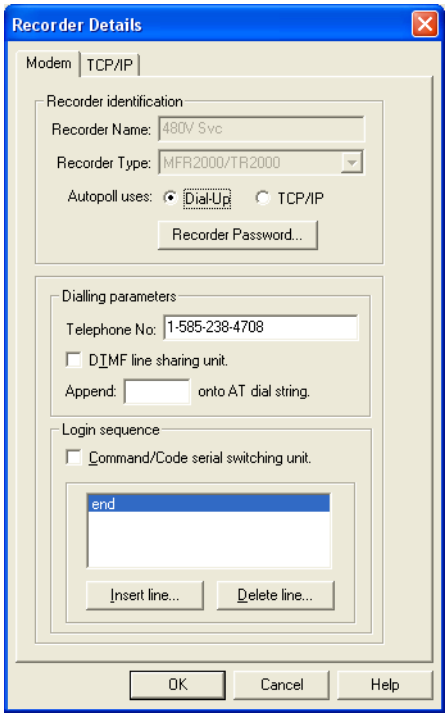

Figure 2.38 Recorder Network - Modem Tab

2. Select a *Recorder Type* from the drop down, during original configuration only.
3. Click a radio button in *Autopoll uses*.
4. Click **Recorder Password** and the Recorder Password appears dialog (Figure 2.39).

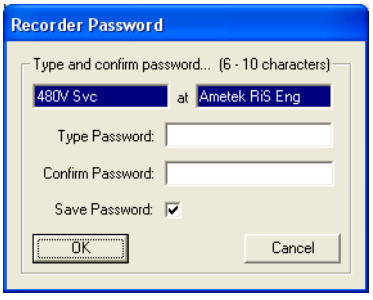

Figure 2.39 Recorder Password

5. Enter the password in both fields, if required, and click **OK**.
6. Enter a *Telephone No*.
7. Click the **DTMF line sharing unit** check box, if required, and enter the two-digit number to append to the phone number in the *Append* field. For best results the two digits should be different.
8. Configure the Login sequence, if required, by:
   a. Clicking the **Command/code serial switching unit** check box.
   b. Click **Insert Lin**e and the Insert Login dialog appears (Figure 2.40).

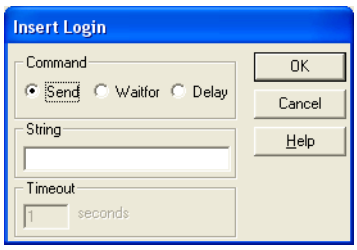

Figure 2.40 Insert Login

   c. Click a ***Command*** radio button and enter a value in the String field, if active, and a Timeout (1-60 seconds), if active.

To delete a line:

- Select the line and click **Delete Line**.

To insert a missing line:

- Click on the line below where the line is to go and click **Insert line** and use the Insert Login dialog.
   d. Click **OK**.

9. Click the **TCP/IP** tab (Figure 2.41).

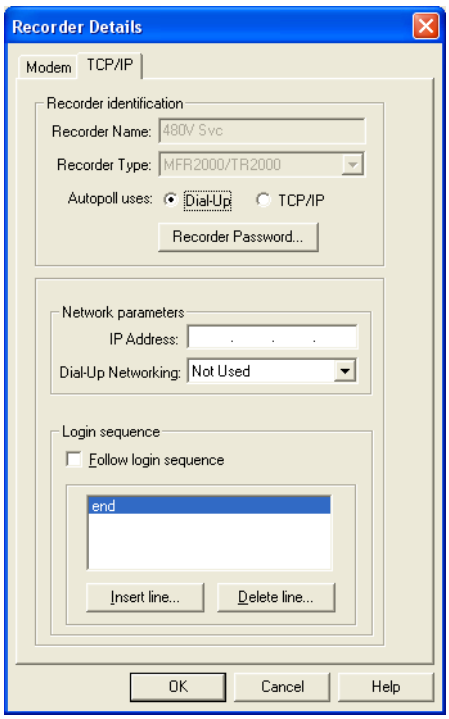

Figure 2.41 Recorder Network - TCP/IP Tab

10. Select a *Recorder Type* from the drop down, during original configuration only.

11. Click a radio button in *Autopoll uses*.

12. Click **Recorder Password** and the Recorder Password appears dialog (Figure 2.39).

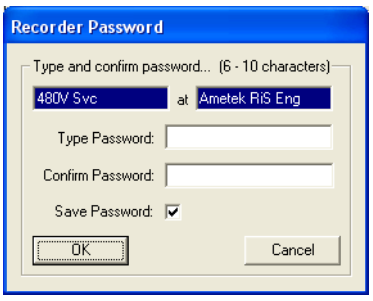

Figure 2.42 Recorder Password

13. Enter the password in both fields, if required, and click **OK**.

14. Enter the *Network Parameters IP Address*.

15. Select a *Dial-Up Networking* option from the drop down.

16. Configure the Login sequence, if required, by:

a. Clicking the **Follow login sequence** check box.

b. Click **Insert Lin**e and the Insert Login dialog appears (Figure 2.40).

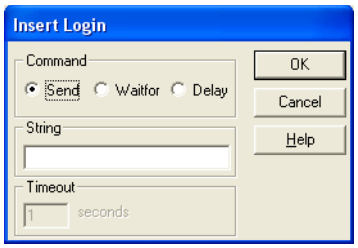

Figure 2.43 Insert Login

c. Click a **Command** radio button and enter a value in the String field, if active, and a *Timeout* (1-60 seconds), if active.

To delete a line:

- Select the line and click **Delete Line**.

To insert a missing line:

- Click on the line below where the line is to go and click **Insert line** and use the Insert Login dialog.

17. Click **OK**.

18. Click **OK** to exit Recorder Network - Edit.

Pseudo Machine

A pseudo machine (PM) allows the viewing of a number of co-sited recording instruments as one large recorder from Display Station. Using this you can create an instrument with up to 160 analogue and 320 digital channels with record generation that includes all the key signals from a large substation.

The following rules must be met:

- The constituent recorders of a pseudo machine must be the same type and must be cross-triggered.
- A common time sync source must be used (GPS, IRIG-B, etc.).
- The recorders use a local Ethernet network connection.
- For a network enabled site, the recorders are linked to the LAN.
- For a site accessible via PSTN, connect the recorders to a dial-up LAN modem.

Configuration

Display Station configures the common parameters in each recorder of a pseudo machine to be identical. These include:

- Sampling rates
- Recording times (transient & disturbance)
- Time & date
- Peripherals (network)

NOTE

It is important that individual configurations are not edited. If the pseudo machine configuration is edited using Display Station all the recorders are updated together.

The channels of the individual machines are concatenated so that the maximum channel number available is 160. Display Station determines that the correct channel configuration is assigned to the correct machine. If 32 channel recorders are used, there may be up to 5. If 8 channel recorders are used, there may be up to 20. Recorders are not required to have the same channel counts.

Communications

A PM can be contacted in the same way as standard instruments, either manually or via auto-poll or auto-call. Display Station determines whether there are actually a number of instruments making up the PM. Records recovered from the recorders of a PM are combined to form a single record that is available in the record directory for viewing and analysis in the normal way. All record types are included:

- Transient records
- Disturbance records
- Disturbance logger
- Long term logger
- Harmonics logger
- Flicker logger
- Imbalance logger
- Energy logger

Pseudo Recorder Operations

The most efficient manner to create a PM is to create individual recorders, add a pseudo machine at the site, click and drag each recorder onto the PM and then re-order the recorder sequence, if required.

There may be multiple pseudo machines at a location as well as individual recorders.

To add a pseudo recorder:

1. Edit Network Dial-up Networking for a PM accessed over a dial up circuit. This is not required if the recorders are available on a WAN/LAN.
2. Add individual recorders for use in the PM as per "Recorder Network - Edit Operations" on page 2-34 using the recorder IP address and selecting Dial-Up Networking.

   The individual recorders that make up a pseudo machine must all be configured the same way. The hardware set up must have:

   - Cross-triggering
   - Network support
   - Common time sync

   The Modem, Terminal Adapter and Network Hub can all exist in the same unit. These are normally termed a dial-up network modem. Specifically, this could be a product like a 3Com OfficeConnect 56k LAN modem. Up to four recorders can be connected to this but more may be included by adding a standard Ethernet hub.

NOTE

It is important that the network administrator is contacted before selecting the IP addresses and subnet masks for the recorders that make up a PM.

Refer Table 2.2 for pseudo recorder channel assignments.

Table 2.2 Pseudo Machine Channel Assignments

Recorder Name	Individual recorder channel numbers	Pseudo recorder channel numbers
Recorder #1	1 – 32	1 – 32
Recorder #2	1 – 32	33 – 64
Recorder #3	1 – 32	65 – 96
Recorder #4	1 – 32	97 – 128
Recorder #5	1 – 32	129 – 160

NOTE

Use the substation as the connection name for simplicity. A login sequence is not normally used for this type of connection.

3. Repeat this for all the recorders that are to make up the PM.
4. Build a Pseudo Machine by:
    a. Right-clicking on the **Location Name** and selecting *Add Pseudo recorder.*
    b. Right-clicking on the new default PM name and select *Rename Pseudo Recorder* and changing the name to the required one.
    c. Click and drag the individual recorder names in the Recorder Network - Edit window onto the pseudo recorder name.
5. Click **OK**.

NOTE

Individual recorders must be listed in the correct order as this determines the sequence of the input channels. If the initial order is not correct:

a. Click on the PM name and select Edit Pseudo Recorder Details (Figure 2.44).

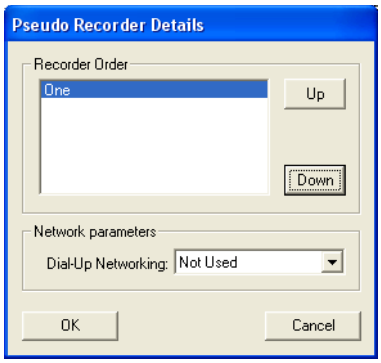

Figure 2.44 Pseudo Recorder Details

b. Select an offending recorder name and click Up or Down to move it to the correct location.

c. **Click OK.**

Merge Records Now

Use this option to manually initiate the record merging process. Records that have originated from a pseudo machine but have not been merged are now processed. This process happens automatically after the recorders have been auto-polled. Cross-triggered records that can be merged may have slightly different trigger times.

Communications Status

Displays the status of any active communications process.

Buttons and Fields

The display window lists for each active process:

- Machine Name
- Location
- Job Description
- Step
- Progress - for file transfers
- Speed

For a file transfer the number of bytes transferred, the data rate and the time remaining are all displayed.

Cancel	Cancels a communications process for the active entry. You are required to confirm before jobs are cancelled.
Cancel All	Cancels all communications processes. You are required to confirm before all jobs are cancelled.
Hide	Hides the display.
Always on top	Click to keep the status display on top of any other window.

Communications Status Operations

To open Communications Status:

1. Select *Edit > Communications Status* or double-click on the blue status bar at the bottom of the main window.

   The Communications Status window appears (Figure 2.45).

2. Select an active communications process using the mouse or by holding down the <Alt> and pressing the <Tab> key repeatedly until the Task window shows *Communications Status*, then release both keys.

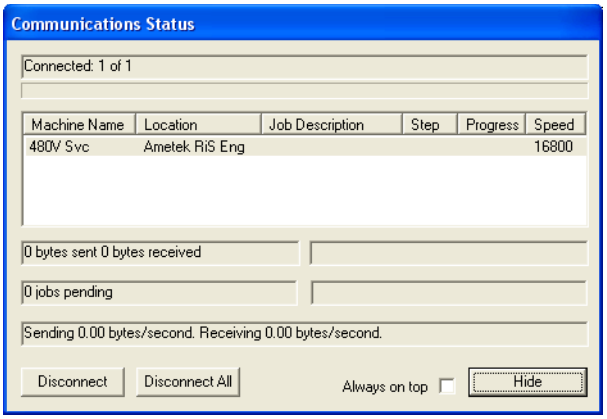

Figure 2.45 Communications Status

3. Click on an entry to see the details in the text boxes at the bottom of the window. If only one process is running its details automatically appear.

Recorder Menu

This menu is used to connect to recorders, configure them and to download records from them. Most options are not available until a connection is made. The options available are:

- "Connect" on page 2-52
- "Disconnect" on page 2-54
- "Configure - Configure a Recorder" on page 2-54
- "PQR Set up Wizard (PQR)" on page 2-133
- "Event Log" on page 2-141
- "Manual Trigger" on page 2-142
- "Transient Record Download" on page 2-143
- "Harmonic Records" on page 2-150
- "Logger Records" on page 2-152
- "Disturbance Records (TR2000, TR100+ & PQR)" on page 2-154
- "Disturbance Logger (TR2000)" on page 2-158

Connect

Connects to a recorder locally or remotely via a modem or network (Figure 2.46). This is identical to the *tree* control used to configure the Recorder Network. There is a hierarchal structure of:

- Recorder Network
- Regions
- Locations
- Recorders

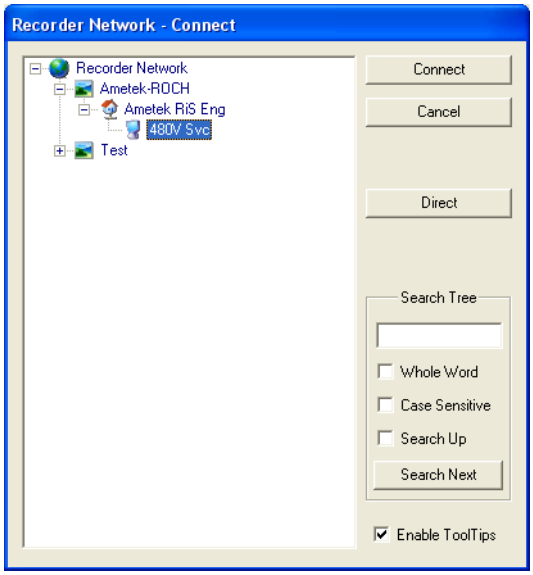

Figure 2.46 Recorder Network - Connect

The status bar includes a description of the number of active connections and jobs active and pending at any time. To view details on individual connections double click on the text box and the Communications Status window appears ("Comms Manager" on page 2-23).

At the bottom left of the main window are two colored boxes for a manual and automatic connection. The colors indicate:

- Red - No connection active
- Yellow - Connection in progress and incomplete
- Green - Connection complete

Buttons and Fields

Search Tree

Searches the recorder network to find a particular region, location or recorder. This is very useful if there are a large number of recorders in the network. Check a relevant box to enable other options:

Whole word	Ensures that a word must match completely in a search. The default is that partial matches can be found.
Case sensitive	Activates case sensitivity for the search.
Search up	Makes the search go up the tree. The normal search order is top down.
Enable ToolTips	Enables the display of information about an object when the cursor moves over its name.
Direct	Opens a connection to a local serial-connected recorder. This may be password protected.

Recorder Network - Connect Operations

Connect to a Recorder

To connect to a recorder:

1. Select *Recorder > Connect* or click  .

   The Recorder Network - Connect dialog appears (Figure 2.46).

2. Select a recorder and click **Connect** to make a remote connection or click **Direct** to make a local serial connection.

   A Recorder ID Mismatch dialog may appear (Figure 2.47 on page 2-54) if a connection is made to a recorder and the recorder name has been changed, either on the recorder itself or in Display Station network definition, since the last time the recorder was connected.

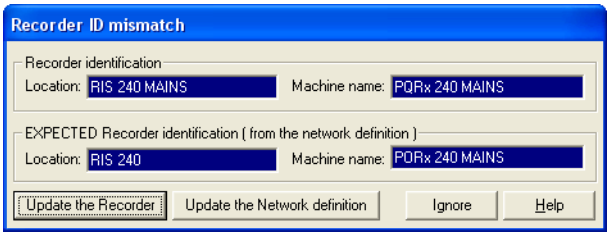

Figure 2.47 Recorder ID Mismatch

The following appears on the dialog:

- Recorder identification - Displays the Location and Machine Name that the recorder has stored in its configuration.
- Expected Recorder Identification - Displays the Location and Machine name for the Network definition that Display Station has stored.
- Click **Update the Recorder** to change the names on the recorder to the names in Display Station 32's Network definition.
- Click **Update the Network Definition** to update the names in Display Station's Network definition to the names on the recorder.
- Click **Ignore** to do nothing. In this case, the next time the recorder is connected, this window appears again.

The main window reappears.

Disconnect

To disconnect a connected recorder:

- Select *Recorder > Disconnect* or click  . It takes a modem several seconds to disconnect.

Configure - Configure a Recorder

Use this window (Figure 2.49) to select a recorder and configure or change its set-up parameters. If a recorder is:

- Connected, then the edits are made on-line with a real time display of recorder input signals. To save changes on the recorder, click **Setup**.
- Disconnected edits are made off-line and are downloaded to the recorder the next time it is connected. In this case, you must select the recorder.

To select the recorder:

1. Select *Recorder* > *Configure* or click  .
2. Navigate to the recorder and click **Configure**.

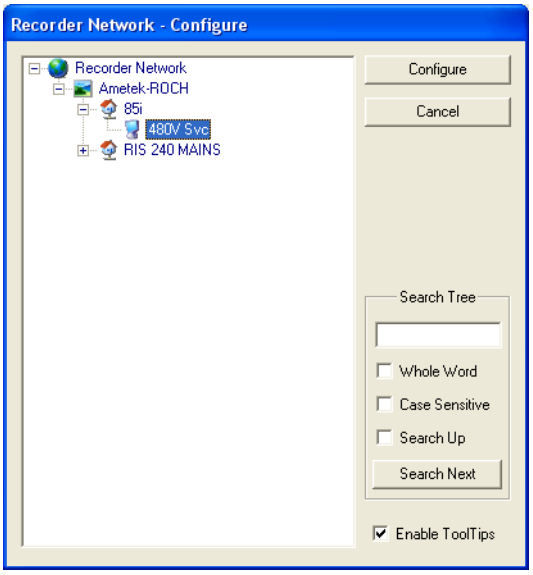

Figure 2.48 Recorder Network - Configure

A Recorder ID Mismatch dialog may appear. Refer to ″Recorder Network - Connect Operations″ on page 2-53.

If there is any concern about the validity of a current configuration this option can be forced by holding down the Shift key while clicking on Configure. This allows the viewing of the file without changing the file on the PC. The Recorder or Local configuration can then be updated to ensure they are identical.

NOTE

See ″Recorder Network″ on page 2-32 for an explanation of the buttons and fields on this window.

Its Recorder Configuration window appears (Figure 2.49).

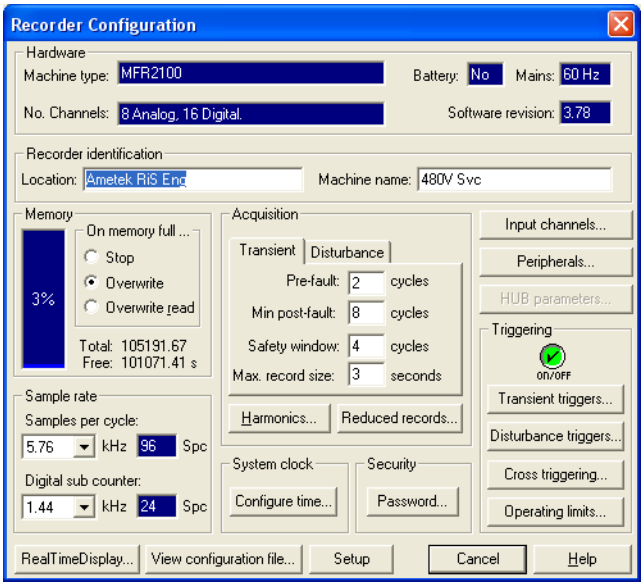

Figure 2.49 Recorder Configuration

Buttons and Fields

The type of recorder dictates the options available and whether it is on-line or off-line.

Hardware — Describes the type of recorder connected or selected. The recorder type and model, the number of channels, whether a battery is installed, the frequency of the mains supply and software revision number appear.

Recorder Identification

Displays the Location and Machine name to uniquely identify each recorder.

Memory

Indicator — Shows how much of the recorders memory (including hard disk) is currently used up (on-line only).

Total/Free — Indicates how many seconds of potential transient recording time there are on the recorder and how many seconds of potential recording time are currently available.

NOTE

Take care, as this does not take into account the 1024 event limitation in the recorders.

On memory full — Use these radio buttons to specify an action if recorder memory becomes full. The choices are:

- *Stop* - stop recording.
- *Overwrite* - overwrite the memory starting from the oldest record.
- *Overwrite read* - overwrite the memory starting from records marked as read.

Setup/Save — Click to save changes, either locally or to a connected recorder.

CAUTION

A warning appears when connected to a TR100 with no hard disk indicating that changes made to the sample rate affects recorder records. As the recorder has no hard disk, the configuration is not stored separately for each record.

Acquisition — Specifies general record duration parameters. Parameters can be specified for transient and disturbance records (TR2000 & TR100+).

If the extended waveform capture option is available on the PQR it is also editable. If not, the values are 4, 12, 0, 1(Figure 2.50). Refer to Table 2.3 for recommended settings. The PQR can have adjustable parameters for both the transient and disturbance recording.

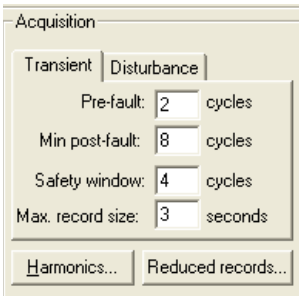

Figure 2.50 Recorder Configuration Window - Acquisition Parameters

Table 2.3 Acquisition Transient and Disturbance Tab Settings

Recording times	TR100	TR100+	TR2000 +	PQR *
Pre-fault (Trans)	2 – 600 c	2 – 300 c	2 – 600 c	4 – 30 c
Min post-fault	8 – 100 c	8 – 100 c	8 – 100 c	4 – 50 c
Safety window	0 – 16 c	0 – 16 c	0 – 16 c	0 – 20 c
Max record length	1 – 60 c	1 – 30 c	1 – 60 c	1 – 2 c
Pre-fault (Dist)	NA	2 – 600 s	10 – 600 s	1 – 10 s
Min post-fault	NA	4 – 300 s	30 – 300 s	1 – 10 s
Safety window	NA	0 – 120 s	0 –120 s	0 –20 s
Max record length	NA	10 – 1200 s	60 – 1800 s	1 –2 s

* PQR requires the Extended Waveform option to modify the transient recording times.

+ On larger TR-2000 systems, at higher sample rates, the buffer memory limits the maximum record size.

Transient Tab

Pre-fault	Number of cycles to record before a fault occurred
Min post-fault	Minimum number of cycles to record during a fault
Safety window	Number of normal cycles that must be recorded after all new triggers return to normal state, including hysteresis, before recording terminates.
Max record size	The maximum size of a record in seconds

Disturbance Tab

Pre-fault	Number of seconds to record before disturbance occurred
Min post-fault	Number of seconds to record during a disturbance
Safety window	Number of normal cycles that must be recorded after all new triggers return to normal state, including hysteresis, before recording terminates.
Max record size	The maximum size of a record in seconds

Sample Rate

Sets the rate at which the recorder samples the data on each channel. To adjust the sample rate:

- Select a new sample rate from the drop down. For TR2000 recorders, the rate at which digital samples are sampled can be set independently of analog channels. To select a new digital sample rate, select the required rate from the Digital sub counter drop down.

Harmonics

The configuration is different for:

- "Harmonics Configuration – TR100" on page 2-60
- "Harmonics Configuration – TR2000, TR100+ & PQR" on page 2-61

Use this window (Figure 2.51) to set up the parameters for recording and retrieving harmonic data.

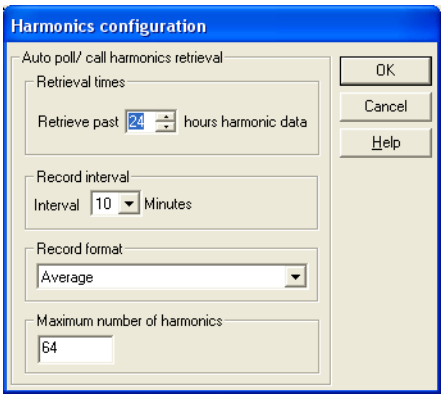

Figure 2.51 Harmonics Configuration

Harmonics Configuration – TR100

Use this window (Figure 2.52) to set up the parameters for recording and retrieving harmonic data.

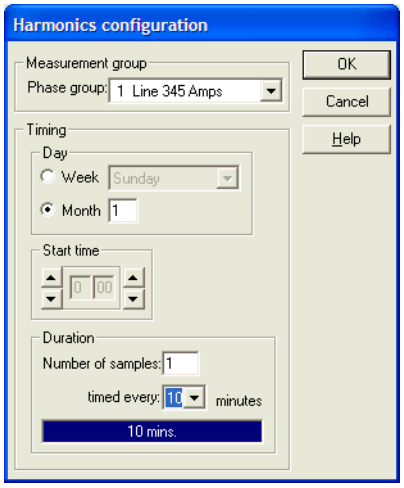

Figure 2.52 Harmonics Configuration - TR100

Buttons and Fields

Measurement Group

Use the phase group drop down to choose which phase group to use for recording harmonics.

Timing — Set up a recorder to record harmonic data on a weekly or a monthly basis.

TR100 Harmonics Configuration Operations

To configure TR100 Harmonics:

1. Click either the:
   - *Week* radio button and select a weekday from the drop down.
   - *Month* radio button and enter a day of the month in the edit box.
2. Enter the time of day for the harmonic recording to start in the *Start Time*.
3. Enter a value in the *Number of Samples* field and enter the *Number of Harmonic Samples*, if required. Samples can be taken every 10, 30 or 60 minutes. The total time being recorded is appears in the blue edit box at the bottom of the main window.
4. Click **OK**.

Harmonics Configuration – TR2000, TR100+ & PQR

A TR2000, TR100+ & PQR records harmonics over all phase groups continuously. This creates a harmonic log that can be recovered manually or automatically during auto-poll. Automatic recovery is enabled in the auto-poll menu and the individual parameters are set in each recorder.

Buttons and Fields

Record retrieval times

States the number of hours of harmonic data to retrieve when the recorder is auto-polled. During an autopoll, if the option to get harmonics is set, the recorder sends back the number of hours of harmonics data required or at least from the start of the current logger block if it is fragmented.

Record interval — Specifies the intervals at which the harmonics data is retrieved. Choose from 10, 30 or 60 minutes. The default is 10 minutes.

Record Format — Select the data to retrieve for each harmonic. The options available are:

- *Average* - Average magnitude of Harmonics over a specified time period.
- *Max, Min, Average* - Max, Min and Average magnitude of Harmonics over a specified time period.
- *Max, Min, Average, Magnitude & angle* - Max, Min and Average magnitude of Harmonics over a specified time period and the Magnitude and angle at the start of that period.
- *Magnitude, Angle* - Magnitude and angle of Harmonics at the start of each specific time period.

The TR100+ records only the average harmonic values.

Maximum number of Harmonics

Enter the maximum number of harmonics to retrieve. Allowed values are 1- 64.

TR2000, 100+ and POR Harmonics Configuration Operations

To configure TR200, TR100+ and PQR harmonics:

1. Click **Harmonics** and the Harmonics Configuration dialog appears (Figure 2.51).
2. Use the spinner to set the *Retrieval times* in hours to capture back to.
3. Use the spinner to set the *Record interval* in minutes.
4. Use the spinner to set the *Record format*.
5. Enter the *Maximum number of harmonics*.
6. Click **OK**.

Record Reduction

Record reduction consists of:

- ″Record Reduction – Transient (TR2000 & TR100+)″
- ″Record Reduction – Disturbance (TR2000 & TR100+)″ on page 2-63
- ″Record Reduction – Disturbance logger (TR2000)″ on page 2-64

Record Reduction – Transient (TR2000 & TR100+)

Use this window (Figure 2.53) to reduce the amount of transient record data downloaded from a recorder during auto-poll, auto-call or a manual connection. The data specified here is selected from the records of the recorder. The complete records are left on the recorder and can be downloaded at a later stage, if required.

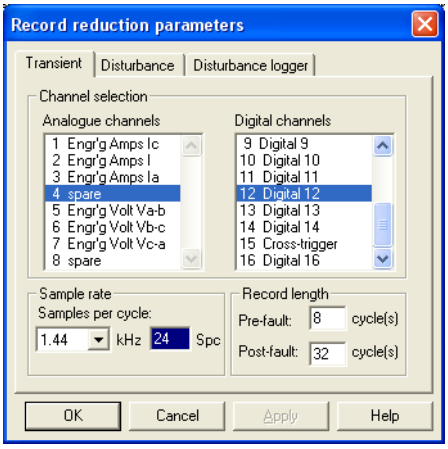

Figure 2.53 Record Reduction Parameters - Transient Tab

Buttons and Fields

Channel Selection — Select channels for download. To select multiple channels hold down the *<Shift>* or *<Ctrl>* keys while clicking on the channel names.

Sample rate — Use the drop down to select a sample rate for the reduced data. The samples per cycle for the selected sample rate appear to the right.

Record Length — Use Pre-fault to enter the number of pre-fault cycles to retrieve. This is taken immediately before the trigger point (range 2 - 100).

Use Post-fault to enter the number of post fault cycles to return. This is taken from immediately after the trigger point. (range 2-100).

NOTE

Pre/post settings are not compared to the recorder configuration to ensure values set are less than actual settings.

Record Reduction – Disturbance (TR2000 & TR100+)

Use this tab (Figure 2.54) to reduce the amount of disturbance record data downloaded from a recorder during auto-poll, auto-call or a manual connection. The data specified here is selected from the records of the recorder. The complete records are left on the recorder and can be downloaded at a later stage if required.

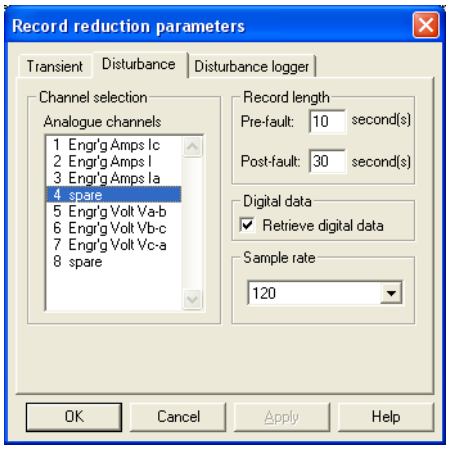

Figure 2.54 Record Reduction Parameters - Disturbance Tab

Buttons and Fields

Channel Selection — Select channels for download. To select multiple channels hold down the *<Shift>* or *<Ctrl>* keys while clicking on the channel names.

Record Length

Use Pre-fault to enter the number of pre-fault seconds to retrieve. This is taken immediately before the trigger point (range 10 - 600).

Use Post-fault to enter the number of post fault seconds to return. This is taken from immediately after the trigger point (range 30-300).

NOTE

Pre/post settings are not compared to the recorder configuration to ensure values set are less than actual settings.

Digital data (TR2000 & TR100+)

Check this box to include the digital data with the record. This can be viewed in SER format from the record header window.

Sample rate

Reduces the effective sample rate from 100 samples per second to 50 or 25. For a 60 Hz system the value is reduced from 120 to 60 or 30.

Record Reduction – Disturbance logger (TR2000)

Use this tab (Figure 2.55) to select download channels.

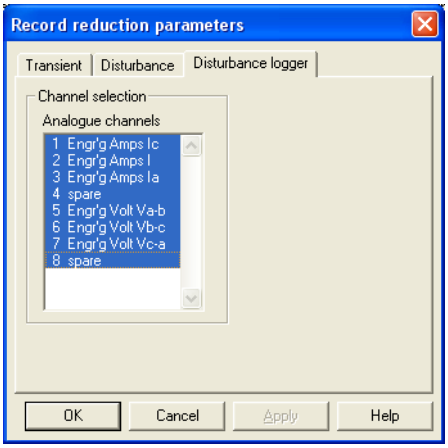

Figure 2.55 Record Reduction Parameters - Disturbance Logger Tab

Buttons and Fields

Channel Selection

Select channels for download. To select multiple channels hold down the *<Shift>* or *<Ctrl>* keys while clicking on the channel names.

Record Reduction Operations

To configure record reduction parameters:

1. Click **Reduced records** and the Record reduction parameters dialog appears (Figure 2.53).
2. Configure the Transient tab by:
   a. Selecting an *Analogue* and/or a *Digital* channel.
   b. Using the spinner to set the *Sample rate*.
   c. Enter the *Record length Pre-fault* and *Post-fault* in cycles.
3. Configure the Disturbance tab by (Figure 2.56):

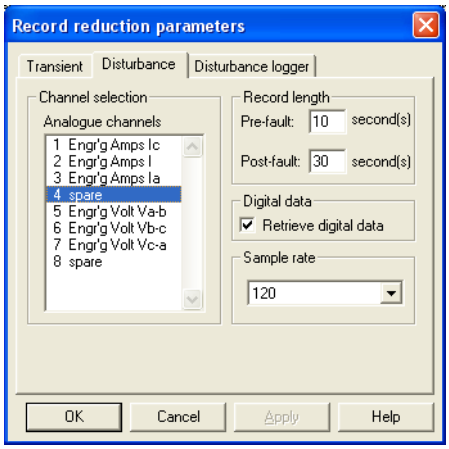

Figure 2.56 Record Reduction Parameters - Disturbance Tab

   a. Selecting an *Analogue channel*(s).
   b. Using the spinner to set the *Sample rate*.
   c. Enter the *Record length Pre-fault* and *Post-fault* in cycles.
   d. Click the **Retrieve digital data** check box, if required.

4. Configure the Disturbance Logger tab by (Figure 2.57):

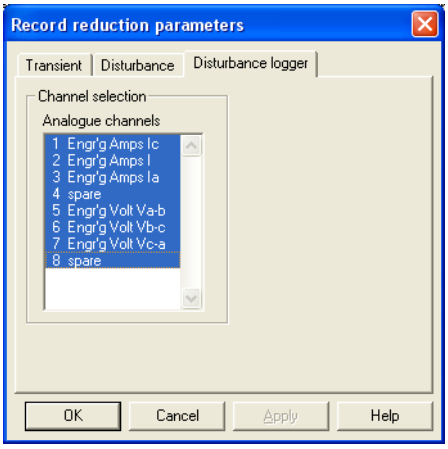

Figure 2.57 Record Reduction Parameters - Disturbance Logger Tab

- Selecting an *Analogue channel*(s).

5. Click **OK**.

System Clock

Use this window to check the time and date of a recorder and to set it to the same time as the local PC.

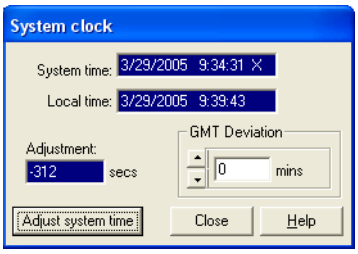

Figure 2.58 System Clock

Buttons and Fields

System time	Shows the time on the recorder.
Local Time	Shows the time on the PC.
Adjustment	Shows the difference between the two clocks.
Adjust System Time	Sets the recorder time to the same time as the PC. This can only be done on a TR2000 if there is no GPS clock present.

If there:

- Is a GPS clock a *G* appears after the time if it locked to GPS time
- Is not a GPS clock an *X* appears.

Recorders with serial time code inputs can be updated but the time reverts to the serial code if it is present and valid. When the time is locked to a serial time code an *L a*ppears after the time. An automatic time update can be done during Auto-poll (see "Options" on page 2-26).

If the PC running DS32 has daylight saving (DLS) enabled, then the recorders that are synchronized from it will also include DLS. A TR2000 that is synchronized to GPS will not include DLS. If DLS is required, change the GMT Deviation value by one hour.

GMT Deviation (TR2000)

Used to express the time difference between the recorder and UTC, that is the time derived from the GPS receiver in the TR2000. This is the time zone the recorder is in relative to GMT; e.g. the GMT deviation for the east coast of USA is –5:00 hours or -300 minutes, if there is no DLS active.

System Clock Operations

To configure the system clock:

1. Click **Configure system time** and the recorder time System clock dialog opens (Figure 2.59).

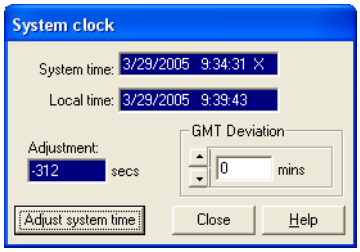

Figure 2.59 System Clock

2. Use the *GMT Deviation* spinners to adjust the time and click **Adjust system time**.

A warning appears (Figure 2.60).

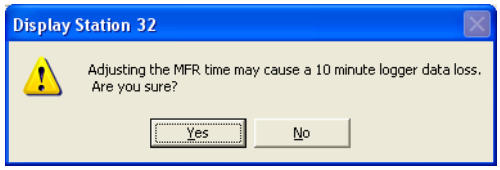

Figure 2.60 System Clock Warning

3. Click **Yes**.

Input Channels

Use this to set up the recorder input channel(s) parameters. For TR100 recorders, Analog channels, Digital Channels, Phase groups and frequency channels are configurable. For TR2000, TR100+ & PQR recorders line groups are also configurable, i.e. the combination of the voltage and current for a particular line or feeder.

The Input Channel Selection window has six possible sections:

- "Analog channels" on page 2-68
- "Digital Tab (TR100, TR100+ & TR2000)" on page 2-71
- "Phase Groups Tab" on page 2-72
- "Frequency Tab" on page 2-73
- "Line Group Tab(TR2000, TR100+ & PQR)" on page 2-74
- "Phasor Display (TR2000 with synchrophasor option)" on page 2-75

Analog channels

This tab lists of the analog channels available. Select multiple channels if configuring them for the same values.

Buttons and Fields

Channel Name — Enter up to a 16-character name to identify each channel with meaningful text.

Nominal — Enter the normal RMS line voltage or current. This is used when values that are displayed as a percentage of nominal or PU are required such as trigger levels. Give neutral current channels a non-zero value so PU triggers can be set.

Full scale

Enter the maximum RMS line level for use as the scaling factor for each analog channel. The value for a voltage channel is:

- VT primary * 212.13 / VT secondary
- For a current channel with an interposing CT the maximum level is:
- CT primary * 1.41412 / (CT secondary / ratio * burden)
- For a current channel with a shunt resistor the maximum level is:
    - CT primary * 20 * nominal shunt value/CT secondary

Specify the full-scale levels for a current channel at least as large as the maximum expected fault current. This is fixed based on the output of the shunt or interposing scaling CT.

Specify a full-scale value for transducer inputs that is the maximum value corrected for the input voltage level. This is 300V for a voltage type or 2V for a current type. The TR2000 and TR100+ have a 12V max. input level available. Other input levels can be specified as a 4th range for these recorders for special applications.

Adjust the full-scale level value slightly to correct for errors in transformer ratios, amplifier gains, etc. If a reliable true RMS signal level is known for an input voltage or current and it differs from the value shown in the analog channel trigger display, correct the value by adjusting the full-scale level thus:

- New full-scale = Old full-scale * measured value / required value

Take care when correcting current channels as normal load current levels are small compared to the full-scale value. For VT (PT) or CT signals the Full Scale would normally be quoted as a primary value.

Units

Enter up to an eight character text string normally be chosen from: A, kA, V or kV or can be any valid engineering unit. It is passed with the record data to the display and to DSA so that data appear in real units.

Frequency Channel (TR2000)

Select the frequency channel for use in correcting calculations for the selected channel. The calculation of RMS, phasor and harmonic levels are slightly affected by changes in system frequency. By selecting a frequency channel these effects are minimized. This correction is automatically set for the TR100+ & PQR.

Channel Set-up (TR2000 & TR100+)

Defines the input signal as either AC or DC or OFF. Defining a signal as AC or DC is used to determine whether the Full Scale value is an RMS quantity. Inputs from normal VTs and CTs are AC and most transducers are DC.

By defining an input as OFF the input data is not processed, downloaded or included in a fault record. This saves communications bandwidth and disk storage space.

Phase Correction (TR2000, TR100+ & PQR)

Enter the phase correction value associated with an interposing CT. This value is used to correct RMS and vector calculations for power and impedance. The procedure for this is included with the calibration manual.

Digital Tab (TR100, TR100+ & TR2000)

This tab (Figure 2.61) sets the parameters of the recorder's digital channels.

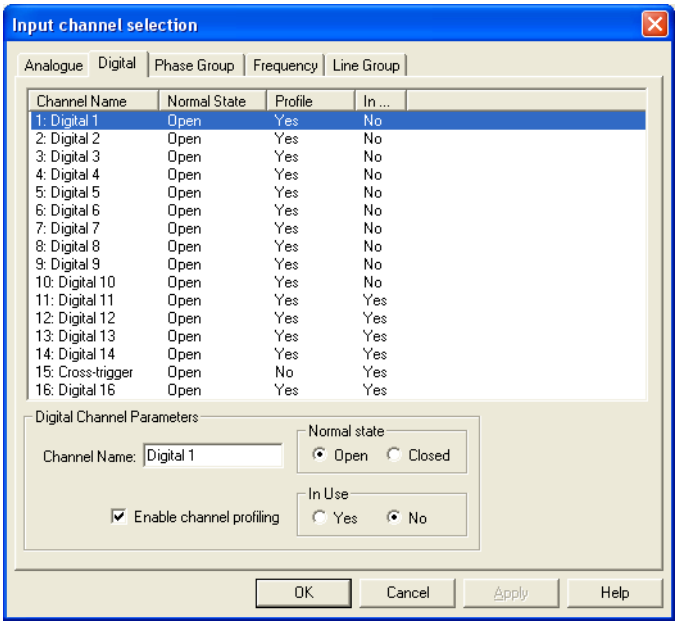

Figure 2.61 Input Channel Selection - Digital Tab

Buttons and Fields

Channel Name — Enter up to a 16-character name to identify each channel with meaningful text.

Normal state — Click Open or Closed to dictate the normal state of the input contact. For a normally closed input there is current flowing through the input circuit.

Enable channel profiling — Enable and the recorder creates a list of all digital channel transitions on enabled channels within a fault or disturbance record so this data is available when retrieving only a record profile.

In Use (TR2000) — Turns an unused channel off completely.

Phase Groups Tab

This tab (Figure 2.62) lists the channels that make up a three-phase voltage or current group to help the graphical display of recorded data and for sequence component triggering. Four phase groups can be defined in a 16 channel system and two are possible in an 8 channel one. There are 10 phase groups available on both the 24 and 32-channel systems.

The Phase Group Name list consists of a list of the phase groups already defined and a group of controls used for selecting the channels for each group. All phase groups should be defined even if they are not used.

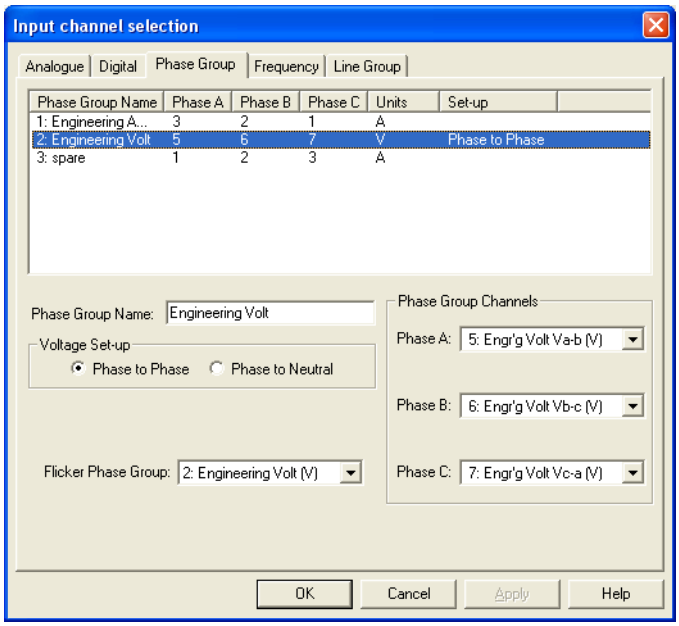

Figure 2.62 Input Channel Selection - Digital Tab

Buttons and Fields

Phase Group Channels

Select the appropriate channels for each phase group. Once a change is made, it appears immediately in the list above.

It is important for correct sequence component triggering that the channels selected for the A, B & C phases are in positive sequence order.

Phase Group Name Enter up to a 16-character name used to identify the phase group with meaningful text.

Voltage Set-up (TR2000, TR100+ & PQR)

Set the type of voltage measurements for use as either phase-to-phase or phase to neutral. This controls the computation of power.

Flicker Phase Group (TR2000)

Defines the voltage phase group used to record flicker in a TR2000. If the current configuration belongs to a pseudo recorder then a Flicker Phase Group can be set up for each individual recorder.

Frequency Tab

This tab (Figure 2.63) defines an analog channel for measuring system frequency. A TR100, TR100+ & PQR recorder allows one frequency channel to be specified and a TR2000 allows two. To ensure an accurate frequency measurement a voltage input is better than a current and phase – phase is better than phase – neutral.

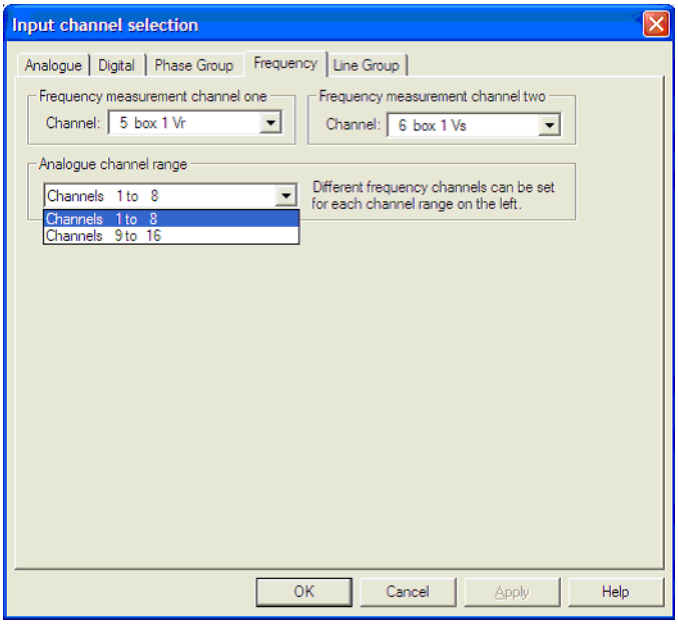

Figure 2.63 Input Channel Selection - Frequency Tab

Buttons and Fields

Frequency measurement channel one/

Frequency measurement channel two

Select the Channel for each.

Analogue channel range (PM)

Set up frequency channel, if the current configuration belongs to a pseudo recorder, for each individual recorder. To select the range of Analogue channels to pick from:

- Click on the down arrow to the right of the field and click on the required range.

Line Group Tab(TR2000, TR100+ & PQR)

Use this tab (Figure 2.64) to define a line group. A line group is made up of two phase groups, one voltage, one current, both from the same line. This is used to compute power and impedance. Define all line groups, even if they are not used.

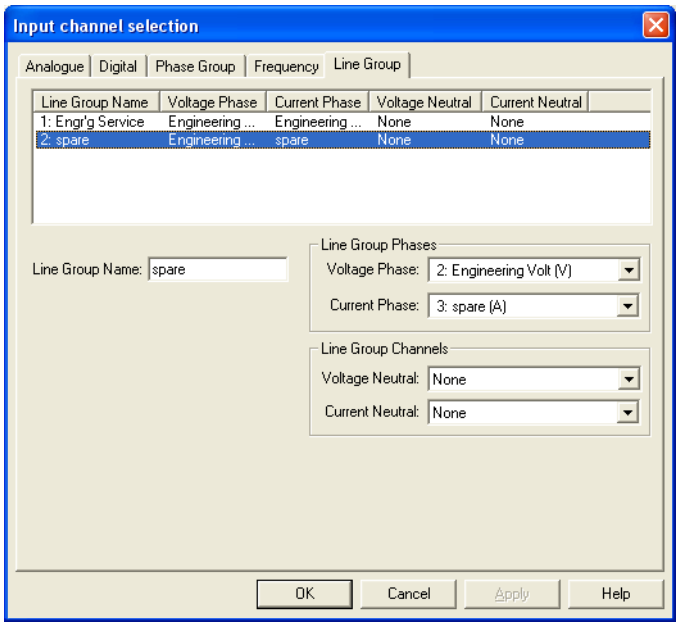

Figure 2.64 Input Channel Selection - Line Group Tab

Buttons and Fields

Line Group Name — Enter up to a 16-character name to identify each channel with meaningful text.

Line Group Phases — Enables the selection of the phase groups for each line group:

- *Voltage Phase* - Select a voltage phase group for the line group. The units must be V or kV.
- *Current Phase* - Select a current phase group for the line group. The units must be A or kA.

Line Group Channels

Enables the selection of the neutral channels for each line group:

- *Voltage Neutral* - Select a channel to associate the neutral voltage to this line group. If none is available select (none).
- *Current Neutral* - Select a channel to associate the neutral current to this line group. If none is available select (none).

Phasor Display (TR2000 with synchrophasor option)

This window (Figure 2.65) sets up a TR2000 recorder for exporting PMU data using the IEEE C37.118 format and for making differential synchrophasor measurements.

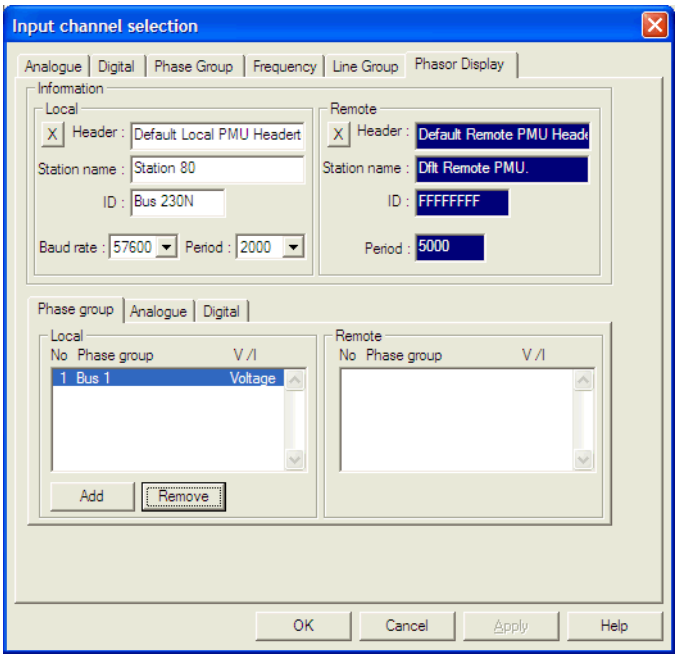

Figure 2.65 Phasor Display

Differential synchrophasor triggering

In the Phasor display configuration screen there are two sections, Local and Remote:

- The *Local* section refers to the recorder that is currently being configured.
- The *Remote* section refers to the other recorder that is being used to make the comparisons. The details of the Remote section only appear if the other recorder is currently connected and set up correctly. Both recorders receive PMU data from the remote end and compute the absolute angle difference and rate of change of angle difference.

C37.118 IEEE Standard for Synchrophasors

When configured, the TR2000 responds to requests for Header and Configuration frames. The Data frames are on by default but can be turned off by using the Data Off command. The Phasor data is in signed 16-bit integer Cartesian format. For more information on the implementation of the C37.118 standard see the TR2000 Application note on Synchrophasor Output

Buttons and Fields

Information

- *Header*
- *Station Name*
- *ID*

These three fields uniquely identify the recorder. To edit the Header text click on the square button to the left. The communications format conforms to IEEE C37.118 that has not yet been ratified.

Baud Rate Sets the Baud rate for the two recorders. The same rate must be set at both ends of the line. When selected, the communications link is made from the Remote comms connector at the rear of the TR2000.

Period

Sets the period used to set the rate at which synchrophasor data frames are sent and received. As this value gets lower, the sample rate gets higher. The same period must be set at both ends of the line. The unit of period is one hundredth of a supply cycle; i.e. a period of 200 would output a PMU data frame every 2 cycles. These frames are synchronized to the 1PPS frame marker from the GPS receiver.

Phase Group

This sets the Phase Groups for monitoring by the recorder.

To select a phase group:

- Click **Add**.

To remove a phase group:

- Select it and click **Remove**.

The order in which phase groups are added is important. When differential phasor triggering is in use, the phase group at the local end is compared with the phase group at the remote end that has the same number. The maximum number of phase groups is 10.

Differential synchrophasor triggering is set up in the Disturbance Triggers - Phase Difference window.

Analogs

Select analog channels for inclusion in the PMU output frame. These would normally be inputs that are not used in the generation of the selected Phase Groups. Analog channels are not used for differential triggering.

Digitals

Select the digital channels for inclusion in the PMU output frame.

Input Channel Operations

To configure input channels:

1. Click **Input channels** and the Input channel selection dialog appears (Figure 2.66).

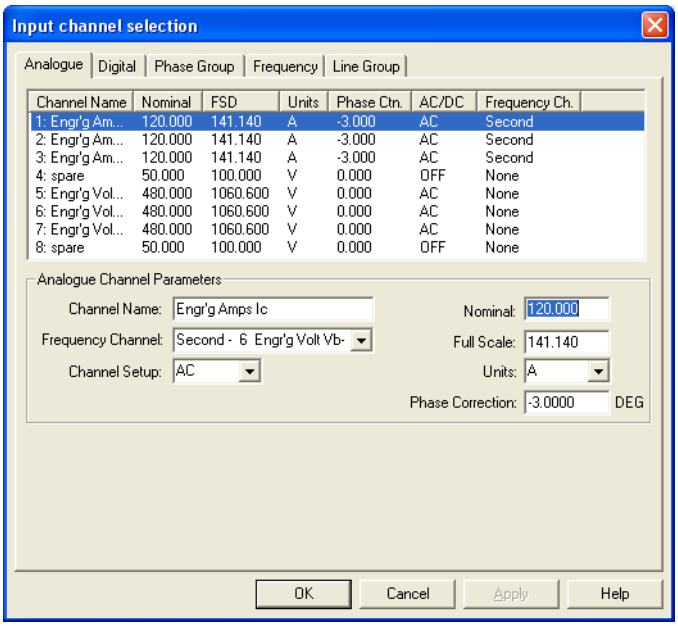

Figure 2.66 Input Channel Selection - Analogue Tab

2. Configure the Analogue tab by:

a. Entering/editing the *Channel Name*.
b. Selecting a channel in the display area.
c. Using the down arrow to select a *Frequency Channel*.
d. Use the down arrow to select a *Channel Setup.*
e. Enter values for *Nominal* and *Full Scale*.
f. Use the down arrow to select *Units*.
g. Enter a *Phase Connection*.

3. Configure the Digital tab by (Figure 2.67):

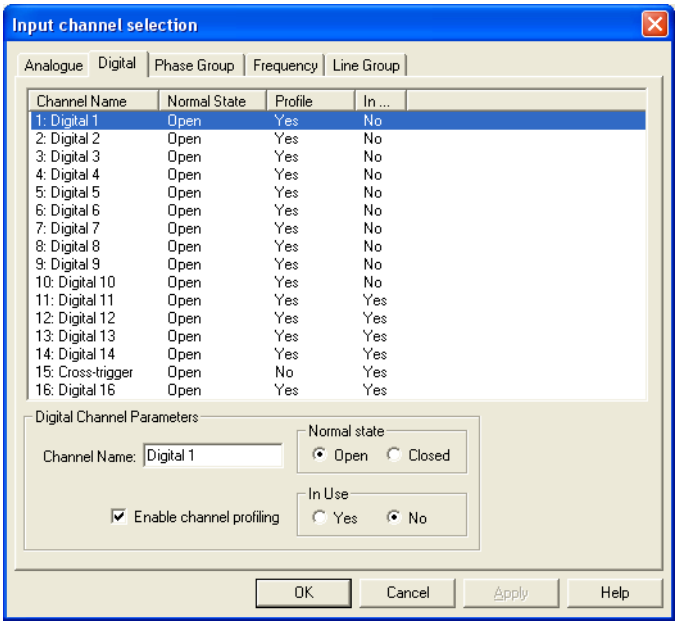

Figure 2.67 Input Channel Selection - Digital Tab

a. Entering/editing the *Channel Name*.
b. Selecting a channel in the display area.
c. Click a **Normal state** radio button.
d. Click an **In use** radio button.
e. Click **Enable channel profiling**, if required.

4. Configure the Phase Group tab by (Figure 2.68):

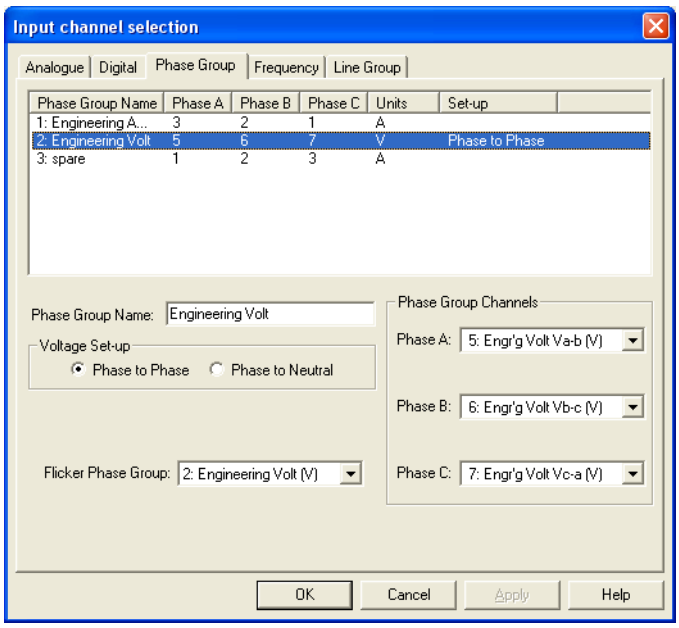

Figure 2.68 Input Channel Selection - Phase Group Tab

a. Entering/editing the *Channel Name*.
b. Selecting a *Phase Group Name* in the display area.
c. Using the down arrow to select a *Phase Group Channel* for each phase.
d. Using the down arrow to select a *Flicker Phase Group*.

5. Configure the Frequency tab by (Figure 2.69):

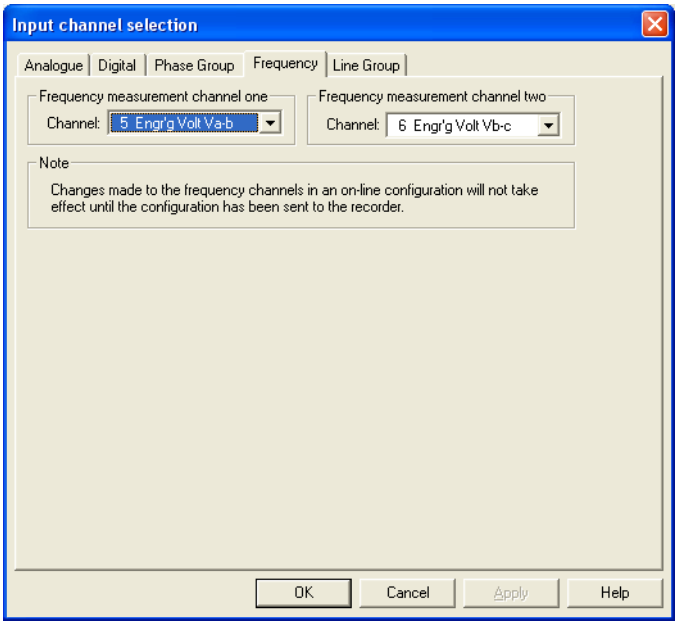

Figure 2.69 Input Channel Selection - Frequency Tab

- Using the down arrow to select a channel for *Frequency* measurement channel one and Frequency measurement channel two, if required.

6. Configure the Line Group tab by (Figure 2.70):

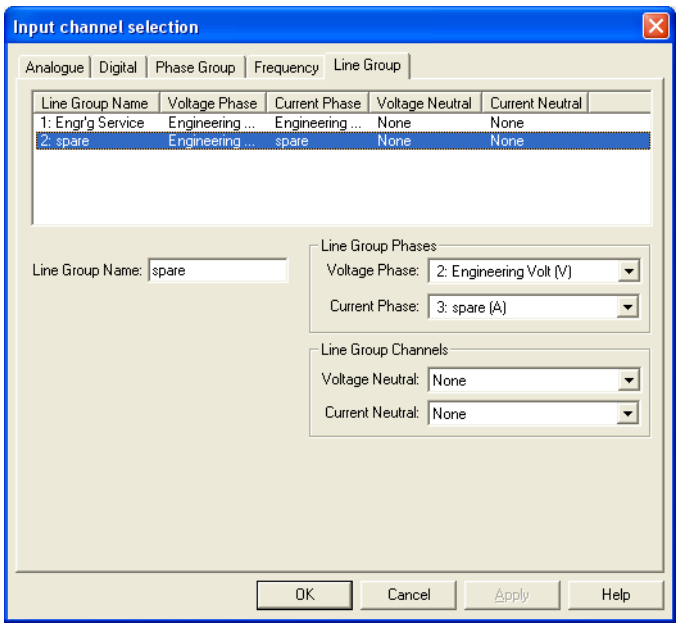

Figure 2.70 Input Channel Selection - Line Group Tab

   a. Entering/editing the *Line Group Name*.
   b. Using the down arrow to select a *Voltage Phase* and *Current Phase* for the *Line Group Phases*.
   c. Using the down arrow to select a *Voltage Neutral* and a *Current Neutral* for each *Line Group Channel*.

7. Configure the Phasor Display tab by (Figure 2.65 on page 2-75), if applicable, by:
   a. Clicking **Add** to add a new Phasor group on the Phasor Group tab.
   b. Entering *Header, Station name* and *ID* names.
   c. Using the down arrow to select a *Baud rate* and *Period*.
8. Click **OK**.

Peripherals

Use this window (Figure 2.71) to set up the peripheral devices for the recorder. The actual items shown depend on the type of recorder and the options chosen at time of order.

There are six peripherals available:

- *Modem* - Sets up a modem-to-modem connection between the recorder and Display Station. If the modem is internal to the recorder the default port is COM 3. This leaves the rear port (COM 2) for DNP, serial time code or synchrophasor (TR2000).
- *Fax* - Sets-up a recorder to fax records on auto-call. This uses the fact that the data modem is also fax compatible. The fax output of a record is similar to the printed output from the recorder.
- *Network* - Shows the connection parameters of a recorder when it is connected over a network.
- *Printer* - Is only available if there is a printer selected on the configuration switches of the recorder.
- *Distributed Network Protocol* - Edit the parameters for a DNP connection, if embedded in the recorder firmware.
- *Serial clock* - Is only available when the recorder is configured for linking to an external serial clock. The clock is connected through the recorder's rear serial port. This option cannot be used at the same time as the DNP 3.0 option. This is also used for some IRIG-B systems. The addition of a PC 104 card or similar device allows a serial time interface in parallel with DNP or PMU.

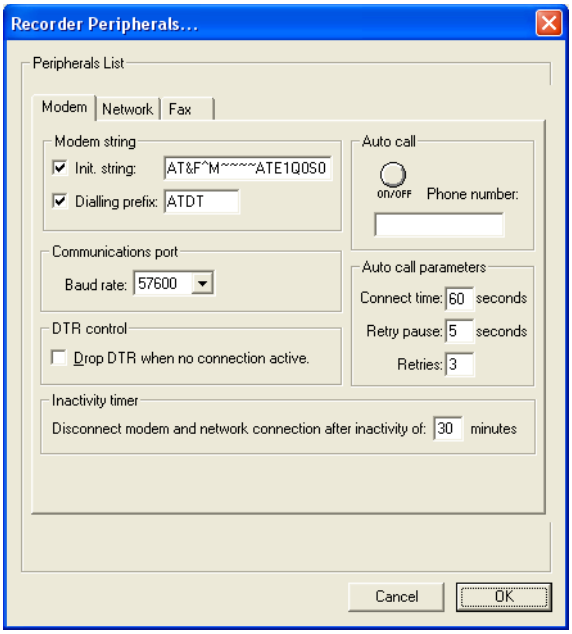

Figure 2.71 Recorder Peripherals - Modem Tab

Modem Tab *Buttons and Fields*

Modem String

Init String

Click the check box and enter an initialization string for the modem. The character *^M* translates to an ASCII carriage return and ~ translates to a half second delay (entered between commands). The default initialization string, which is suitable for most modems, is:

AT&F^M~~~~ATS0=1^M

For US Robotics modems the initialization string is:

AT&F^M~~~~ATE1&B1C1&D2S0=2S7=120^M

Dialing Prefix

Click the check box and enter the string that precedes the phone number. This is used to determine the type of dialing – tone or pulse. This normally is:

ATDT

Communications port

	Baud rate	Select the data rate for the recorder to talk to the modem. This should be greater than the connect speed of the modem: i.e. for a 33600 modem use a baud rate of 57600.
	Inactivity timer	Enter the length of time a recorder stays connected if no communications are occurring (range 2 – 30). This limits costly long distance bills after inadvertently leaving a recorder connected.
	Auto-call	Switch on and the recorder automatically calls the PC when a new fault is recorded.
NOTE	**Auto-call is via either modem or TCP/IP, not both.**	
	Phone Number	Enter the number to dial.

Auto-call parameters

	Connect time	Enter the amount of time a recorder waits for a call to be answered (range 3 – 300).
	Retry pause	Enter the length of time between the end of one dial attempt and the start of the next (range 0 – 999).
	Retries	Enter the number of times a recorder tries to connect to a PC before giving up (range 0 – 99).
	DTR control	Activate to drop DTR when the connection is inactive. This required for some modems.

Fax Tab

Buttons and Fields	*Auto fax*	Click either/both buttons to activate: Alarms and Records: • *Alarms* sends internal alarms to the fax when they occur. • *Records* sends transient records to the fax when they occur.
	Phone number	Enter the fax phone number.
	Init string	Enter the init string for the recorder modem.

	Fax options	Use the drop downs to select display options for the target fax. They are not normally changed from the defaults.
	Comms Options	Use the drop downs to select the communications options between the recorder and the target fax. These are not normally changed.
	Connection Parameters	
	Attempt pause	Enter the length of time to delay between each attempt at dialing the fax.
	Attempts	Enter the number of times to try re-dialing the fax before quitting.

Network Tab

Buttons and Fields	*Network Parameters*	
	IP Address, IP Subnet Mask and *Router IP Addr*	
		Enter values in the fields to give the recorder a unique identity on the network. These parameters can only be changed when the recorder is connected to the PC directly using the RS-232 port.
	Auto-call	
	Auto-call	Switch on and the recorder automatically calls, via TCP/IP, the PC when a new fault is recorded.
	IP address	Enter the address of the host PC. If this is used the Router IP Addr must also be entered. The host PC must have a fixed address. DCHP is not supported.

Auto-call connection parameters

	Retry pause	Enter the number of seconds a recorder waits after trying to connect to a PC before trying again (range 0 – 999).
	Retries	Enter the number of times the recorder attempts to connect to the PC (range 0 – 99).

Distributed Network Protocol Tab (DNP 3.0)

Buttons and Fields

	DNP Parameters	
	IED Address	*Set* a number to identify the recorder on the network (range 1 – 65534).

Transmission delay — Set the time to disable the master transmitter on an RS485 network (range 0 – 65535) (not currently used).

Data Link Confirm

Confirm mode — Set as Never, Sometimes or Always. The default value is Never.

Retries — Set the number of times the recorder retries to connect if Data Link confirmation is required (range 0 – 255).

Time-out — Set the time the IED waits for a Data Link confirmation. Valid numbers are 0 – 65535.

Select/Operate arm time

Set the time period after the select command is received that the operate command is performed (range 0 – 65535) (Not currently used.)

Communications port

Enter the Baud rate of the recorder's rear serial port.

Printer Tab (TR100, TR100+ & TR2000)

Buttons and Fields

Printer type — Select a printer type from the drop down. This defines the escape sequences used by the recorder to set the output printer for graphics printing. The range of available printers includes dot matrix, ink jet and laser types. Most printers can be set to emulate the Epson FX80 or IBM Proprinter.

Auto print — Select Auto print and the recorder prints all records and events as they occur. This can be switched off during set-up to disable records generated during testing from being printed.

Serial Clock Tab

Buttons and Fields

Serial Clock parameters

Time Code — Select a time code type. LER (RCC8000), NGTS 3.7.9 & IRIG-B are supported.

Baud rate — Select the baud rate for communication. IRIG-B defaults to 9600 baud.

Serial Format — Select the appropriate data bits, parity and stop bits for communication with the clock. For NGTS 3.7.9 the default format is 7 data bits, 2 stop and even parity. IRIG-B defaults to 8 bits, 1 stop and no parity.

Peripherals Operations

To configure the peripherals list:

1. Click **Peripherals** and the Recorder Peripherals dialog appears with the Modem tab active (Figure 2.72).

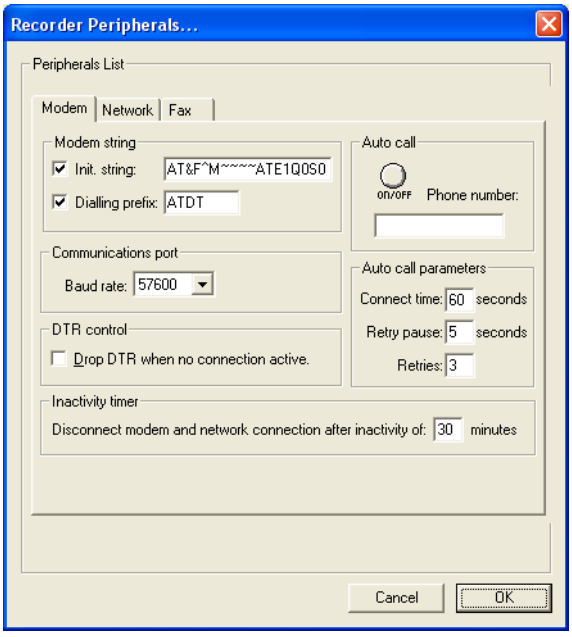

Figure 2.72 Recorder Peripherals List - Modem Tab

2. Configure this tab by:
   a. Clicking the **Int. String** and **Dialing prefix** check boxes to activate the fields and enter values, as required.
   b. Using the down arrow to select a *Communications port Baud rate*.
   c. Click **on/off** in Auto call and enter a *Phone number*, then enter values in all the *Auto call parameter* fields.
   d. Click the **Drop DTR when no connection active** check box.
   e. Enter a value in the *Inactivity timer* field.

3. Configure the Network tab by (Figure 2.73):

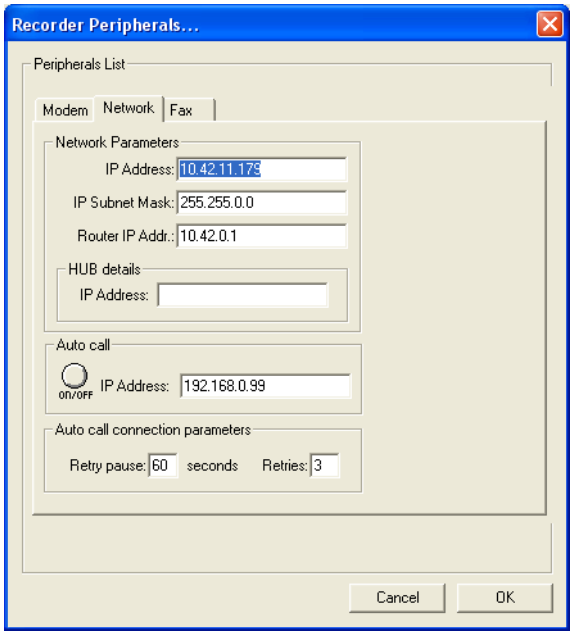

Figure 2.73 Recorder Peripherals List - Network Tab

a. Entering values in the *IP Address*, *IP Subnet Mask*, and *Router IP Addr* fields.

b. Clicking **on/off** in Auto call and entering:

- An *IP Address*
- *Retry pause* and *Retries*.

4. Configure the Fax tab by (Figure 2.74):

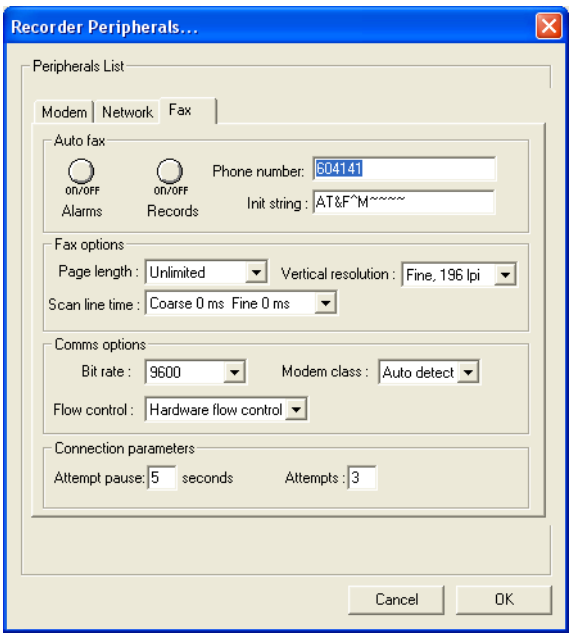

Figure 2.74 Recorder Peripherals List - Fax Tab

a. Clicking **on/off** for Alarms and/or Records and entering:
   - A *Phone number*
   - An *Int string*

b. Using the Fax options down arrows to select a:
   - *Page length*
   - *Scan line time* - recommended setting is Coarse 10 ms, Fine 5 ms
   - *Vertical resolution*

c. Using the Comms options down arrows to select a:
   - *Bit rate* - set the speed no faster than 1/4 the modem speed
   - *Flow control*
   - *Modem class*

d. Entering values in the Connection parameters:
   - *Attempt pause*
   - *Attempts*

5. Click **OK**.

Password

Use this dialog to configure password security to the connected recorder.

Password Operations

To add a password:

1. Click **Password**.

   The Recorder Password Dialog appears (Figure 2.75).

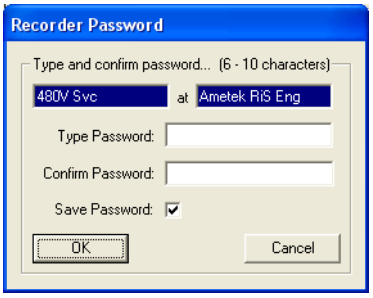

Figure 2.75 Recorder Password

2. Enter a password in *Type Password* and *Confirm Password*.
3. Click the **Save Password** check box to save the password as part of the recorder's network details allowing for seamless connections to that recorder in the future.
4. Click **OK**.

   The Recorder Configuration window reappears.
5. Click **Setup** to assign the password to that recorder.

Transient Trigger Settings

Use this window (Figure 2.76) to set up the conditions that make a recorder recognize a fault condition and transient record. There are five tabs for transient trigger settings:

- Analog Tab
- Digital Tab
- Phase Group
- Frequency
- External (PQR)

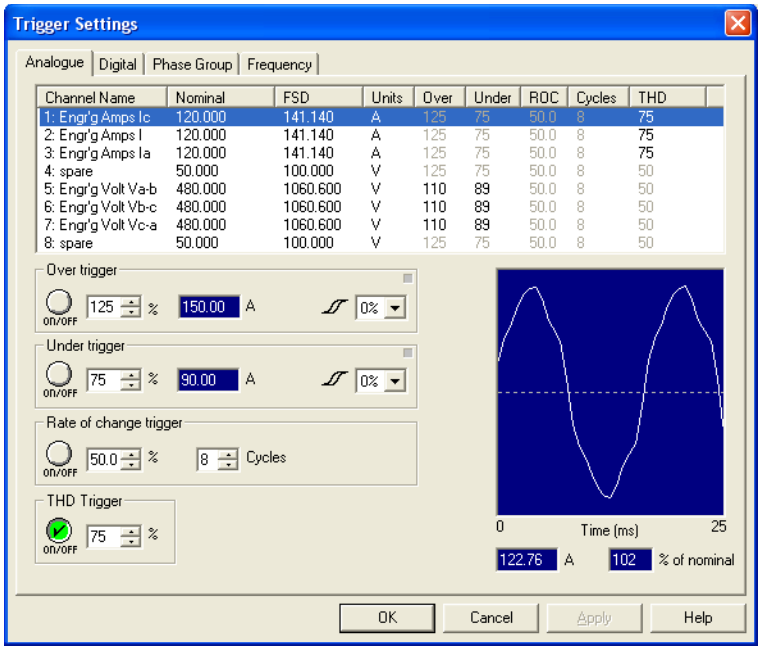

Figure 2.76 Trigger Settings - Analogue Tab

Analog Trigger Tab

Four types of triggering can be set for the analog channels: Over Trigger, Under Trigger, Rate of Change and THD (or Sub-cycle drop out for a TR100).

Buttons and Fields

on/off — Enables/disables each trigger type.

Over trigger/Under trigger indicator

Each has a triggered state indicator to the right of the controls. When a recorder is connected, if either of the level trigger values causes a trigger condition, then this indicator turns red as a warning. This is an indication only and may not be accurate if the waveform is distorted.

Channel Name

Select the analog channel for which the triggering levels are to be set.

Over Trigger % — Sets a high threshold which, when exceeded by a single cycle RMS level of the channel, causes a trigger condition. The trigger condition continues as long as the signal is over the threshold level.

The blue background box shows the actual RMS value that the channel has to reach before triggering. The threshold is calculated as a percentage of the channel's nominal value.

Under Trigger %

Sets a low threshold which, when dipped below by a single cycle RMS level of the channel, causes a trigger condition. The trigger condition continues as long as the signal is under the threshold level.

The blue background box shows the actual value that the channel has to dip below before triggering. The threshold is calculated as a percentage of the channel's nominal value.

Hysteresis - Over trigger/Under trigger

Dictates the difference between the levels required to initiate and terminate a level trigger. The value is defined as a percentage of the channel's nominal value. For example, a 150% over trigger with a 5% hysteresis requires the input level to exceed 150% of the nominal value to start a trigger condition and a level of less than 145% to end it. Hysteresis is most useful for stopping multiple triggers being generated if the signal level is close to the trigger level.

Rate of change trigger

This is a more sensitive mode than threshold triggering, as it is independent of normal input variations, i.e. the daily and annual cycles of load current. For correct application, the pre-fault length must be longer than the duration of the rate of change. Rate of change triggering is based on a peak signal measurement in the TR100 and an RMS signal in the TR2000, TR100+ and PQR. Two values are required to define a rate of change trigger:

% - Select the percentage change in the input level over which the change is measured. The percentage is that of the pre-fault level so the absolute change is smaller for smaller signals. The minimum change that triggers a record is equivalent to 1% of the full-scale value. The change can be positive or negative.

Cycles - Select the number of cycles over which the change is measured.

Sub Cycle Drop Out (TR100)

Activate this trigger mode for very subtle single cycle distortion events to be recorded. The purity of the input signal is measured and variations are recorded as a percentage difference in the area of the input signal relative to a sinusoidal waveform with the same peak amplitude. Enter the difference in the field, the minimum being 5%. For this trigger mode the trigger point is marked as the start of the half cycle that contains the variation.

Total Harmonic Distortion (TR2000, TR100+ & PQR)

Activate this trigger mode and set the percentage (%) to use the TR2000, TR100+ & PQR for quality monitoring. The maximum permissible level of THD can be set for each channel. THD is computed using the fundamental and RMS values every half cycle. This trigger responds to single cycle events.

Waveform Display Shows a waveform if a recorder is currently connected and displays the signal from the currently selected channel. Over and Under triggers appear on the display as blue and green lines respectively. Hysteresis values are indicated by dashed lines.

At the bottom of the display, two edit boxes show the signal RMS value, in real units and as a percentage of the defined nominal value. This is an estimate based on peak values and will not be accurate if the waveform is distorted.

Digital Tab

Figure 2.77 shows the Digital tab.

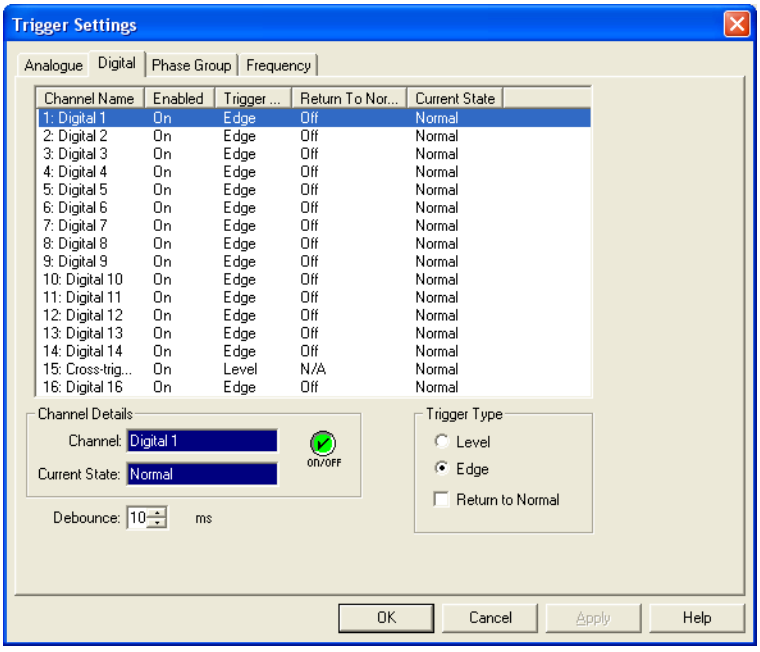

Figure 2.77 Trigger Settings - Digital Tab

Buttons and Fields

Channel details	Displays the name of the channel currently selected.
Current State	Displays the current state of the channel, either Normal or Alarm, if a recorder is currently connected.
on/off	Enables/disables triggering on the selected channel.
Trigger Type	Level triggering causes triggering when the channel goes from normal to alarm state and keeps recording until the channel returns to normal state. Edge triggering, in concert with selecting the Return to Normal check box, causes both the Normal to Alarm and Alarm to Normal changes to generate a minimum length record, if this is the only trigger present.

Debounce Set a debounce value for all the digital input channels. This can be from 1 to 10 ms. Inputs must remain stable for this time before a change of state is recognized. The transition time is taken as the original change of state.

Phase Group Tab

Figure 2.78 shows the Phase Group tab.

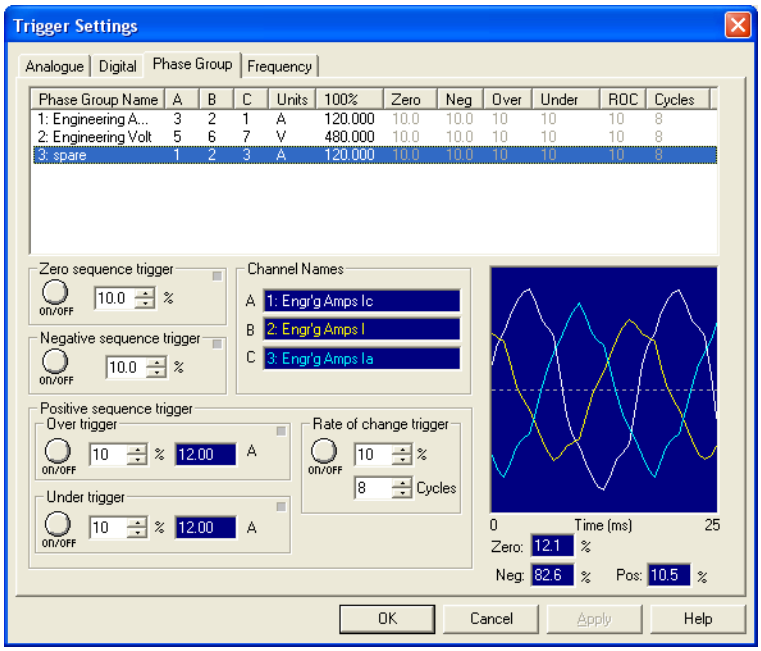

Figure 2.78 Trigger Settings - Phase Group Tab

Buttons and Fields

Phase Group Name

Lists box holds a list of the phase groups for the recorder. To edit the trigger settings for a phase group, select it from the list.

Channel Names Displays the phase group constituent channels (A, B & C) and the nominal value for the first channel (100% =). This nominal value is used as a reference for calculating the thresholds of the phase group triggers.

on/off Enables/disables each type of triggering.

Zero Sequence Trigger

The zero sequence value is calculated by adding the three components of the phase group with no vector rotation. In a balanced system the result is zero.

% — Enter a percentage of the nominal, which the magnitude of the result exceeds before a fault is triggered. In the TR2000 and TR100+ this can be set to a resolution of 0.1%.

Negative Sequence Triggering

The negative sequence value is calculated by adding the three components of the phase group with negative vector rotation. In a balanced system the result is zero.

% — Enter a percentage of the nominal, which the magnitude of the result exceeds before a fault is triggered. In the TR2000 and TR100+ this can be set to a resolution of 0.1%.

Positive Sequence Triggering (TR2000 & TR100+)

The positive sequence value is calculated by adding the three components of the phase group with positive vector rotation. In a balanced system the result equals the nominal value.

Over Trigger — Enter a percentage of the nominal that the magnitude of the result exceeds before a transient record is triggered.

Under Trigger — Enter a percentage of the nominal that the magnitude of the result dips below before a transient record is triggered.

Rate Of Change Trigger (TR2000 & TR100+)

Rate of Change trigger

Select a percentage by which the rate of change must change before causing a trigger situation. The trigger is calculated from the rate of change of the result of the positive sequence calculation.

Cycles — Enter the number of cycles across which the rate of change is calculated.

Waveform Display Displays the waveform if a recorder is currently connected showing the signals from the selected phase group. Below the display the computed positive, zero and negative sequence levels are displayed. This is also a convenient way to verify proper input wire and system configuration.

Triggered State Indicator

The sequence triggers (+, - and 0) have a triggered state indicator. When a recorder is connected, if any of the set values of the triggers would causing a trigger condition, then this indicator becomes red as a warning.

Frequency Tab

A TR2000 recorder can have two frequency channels, a TR100 and TR100+ only one.

Figure 2.79 shows the Frequency tab.

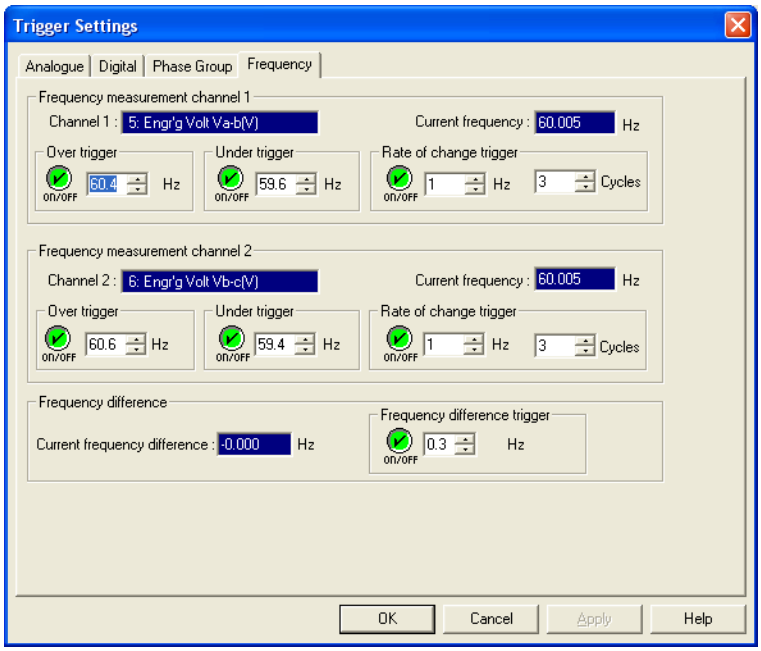

Figure 2.79 Trigger Settings - Frequency Tab

Buttons and Fields

on/off Enables/disables each type of triggering.

Frequency measurement channel 1 & 2

Both of these sections have identical functions. For a TR100 or TR100+ configuration, the Frequency measurement channel 2 is disabled.

Channel 1/Channel 2

Displays the name of the channel selected to act as the frequency channel.

Current Frequency Displays the frequency currently being measured for a connected recorder.

Under Trigger Enter a lower frequency limit. If a frequency is detected which is less than this setting for greater than two cycles then the recorder is triggered.

Over Trigger Enter an upper frequency limit. If a frequency is detected which exceeds this setting for greater than two cycles then the recorder is triggered.

Rate of change trigger

Enter two values to define a rate of change of frequency trigger:

- *Rate of change trigger* - the change in absolute frequency.
- *Cycles* - the number of cycles over which the change is measured.

The maximum interval for rate of change is 8 cycles. Both positive and negative changes are recorded. Only changes within 40 - 60 Hz are accepted for a 50 Hz system and only changes within 50 – 70 Hz are accepted for a 60 Hz system.

Frequency difference (TR2000)

Displays the difference in frequency between frequency channel 1 and frequency channel 2 for a connected recorder. For a TR100 or TR100+ configuration, the Frequency difference section is disabled.

Frequency difference trigger (TR2000)

Enter a value in Hz as the difference in frequencies of frequency channel 1 and frequency channel 2 that if exceeded causes a frequency difference trigger.

Analogue channel range (PM)

Select the range of Analogue channels to pick from by clicking on the Analogue channels drop down, then click on the required range. If the current configuration belongs to a pseudo recorder then triggering for frequency channels can be set up for each individual recorder. For Frequency difference triggering the two source channels must be in the same recorder.

External Tab (PQR)

Select a radio button for the normal state of the PQR digital input that triggers the recorder. This input is not recorded. A normally closed contact has current flowing through the input circuit.

Disturbance Triggers (TR2000)

Use this window (Figure 2.80) to set up the conditions that makes a TR2000 recorder recognize a disturbance fault. There are eight trigger tabs:

- *Analog Fundamental* - Sets up a recorder to trigger on changes to the fundamental of an analog channel. There are three types of trigger available: Over trigger, Under Trigger and Rate of Change Trigger.
- *Power* - Sets up a recorder to trigger on variations of power of a line group.
- *Voltage Imbalance* - Is the ratio of the negative phase sequence over the positive phase sequence expressed as a percentage.
- *Power Factor* - Sets the conditions that cause a disturbance record trigger due to a change in the power factor of a line.
- *Impedance* - Set up the TR2000 recorder to trigger due to impedance changes of a line group.
- *Power oscillation* - Set up triggers to trigger the recorder on power oscillations. The phase groups to be used for each line group measurement are specified in the *Input channels - Line Group* window.
- *Frequency oscillation* - Set up triggers to trigger the recorder on frequency oscillations. The channels to be used for frequency measurement are specified in the *Input channels - Frequency* window.
- *Phase difference (synchrophasor)* - Set up a synchrophasor trigger. Before this trigger is set up, set up the *Phasor measurement channels* on the *Input Channels - Phasor Display* window.

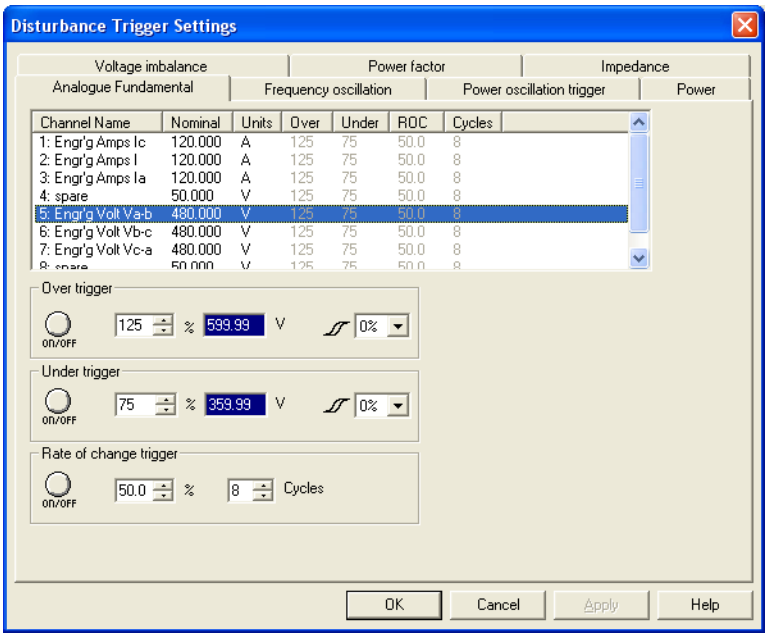

Figure 2.80 Disturbance Trigger Settings - Analogue Fundamental Tab

Analog Fundamental Tab

Buttons and Fields

on/off	Enables/disables each type of triggering.
Analog Channel	Select the analog channel to alter. The settings of the selected channel appear below.
Over Trigger	Select a percentage that is a trigger value as a percentage of the nominal for that channel. If the magnitude of the fundamental rises above this, then a disturbance is triggered. The actual trigger value appears in the blue field to the right.
Under Trigger	Select a percentage, which is a trigger value as a percentage of the nominal for that channel. If the magnitude of the fundamental falls below this, then a disturbance is triggered. The actual trigger value appears in the blue field to the right.

Hysteresis

Sets the difference between the levels required to initiate and terminate a level trigger for both Over Trigger and Under Trigger. The value is defined as a percentage of the nominal input. For example, a 150% over trigger with a 5% hysteresis requires the input level to exceed 150% of the nominal input value to start a trigger condition and a level of less than 145% to end it. Hysteresis is most useful in stopping multiple triggers being generated if the signal level is close to the trigger level.

Rate of Change Trigger

Enter two values to define a rate of change of the fundamental:

- *Rate of change trigger* - the amount by which the fundamental must change as a percentage of the nominal.
- *Cycles* - the number of cycles over which the change is measured.

Both positive and negative changes are detected.

Power Tab

Figure 2.81 shows the Power tab.

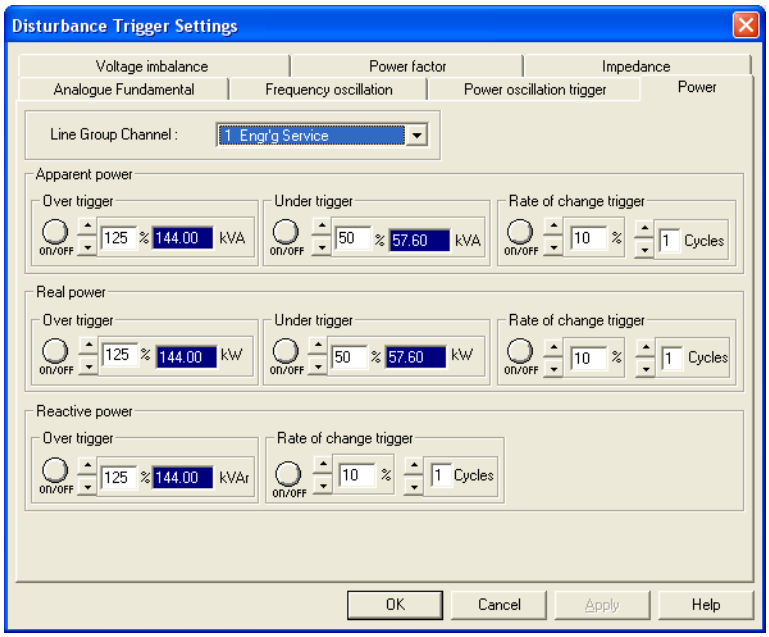

Figure 2.81 Disturbance Trigger Settings - Power Tab

Buttons and Fields

on/off — Enables/disables each type of triggering.

Line Group Channel

Select from the line groups set up in the Line Group section of the Input Channels window.

Apparent Power

Over trigger — Sets the upper limit for the apparent power as a percentage of the nominal apparent power. When apparent power exceeds this level, a disturbance record is triggered.

Under trigger — Sets a lower limit for the apparent power as a percentage of the nominal apparent power. When apparent power drops below this level, a disturbance record is triggered.

Rate of change trigger

This setting is a measurement of how much the apparent power changes over a number of cycles:

- *%* - sets how much the apparent power must change.
- *Cycles* - sets the number of cycles over which this change must occur to cause a disturbance trigger.

Both positive and negative changes are detected.

Real Power

Over trigger — Sets an upper limit for the real power as a percentage of the nominal real power. When real power exceeds this level, a disturbance record is triggered.

Under trigger — Sets a lower limit for the real power as a percentage of the nominal real power. When real power drops below this level, a disturbance record is triggered.

Rate of change trigger

This setting is a measurement of how much the real power changes over a number of cycles:

- % - sets how much the real power must change.
- *Cycles* - sets the number of cycles over which this change must occur to cause a disturbance trigger.

Both positive and negative changes are detected.

Reactive Power

Over trigger — Sets an upper limit to be set for the reactive power as a percentage of the nominal reactive power. When reactive power exceeds this level, a disturbance record is triggered.

Rate of change trigger

This setting is a measurement of how much the reactive power changes over a number of cycles:

- % - sets how much the reactive power must change.
- *Cycles* - sets the number of cycles over which this change must occur to cause a disturbance trigger.

Voltage Imbalance Tab

Figure 2.82 shows the Voltage Imbalance tab.

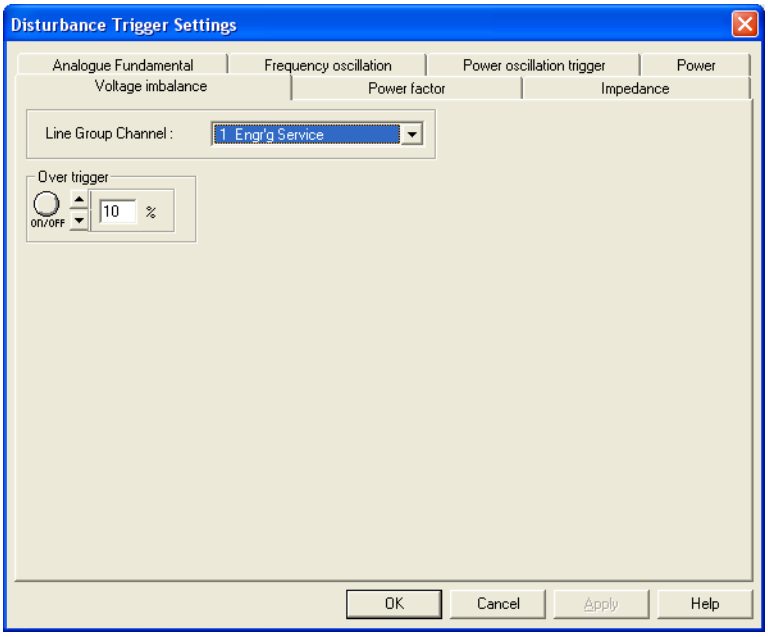

Figure 2.82 Disturbance Trigger Settings - Voltage Imbalance Tab

Buttons and Fields

on/off	Enables/disables each type of triggering.
Line Group Channel	Select the required line group.
Over trigger	Adjust the voltage imbalance ratio.

Power Factor Tab

Line Group Channel	Select the required line group. The trigger details of the selected line group appear below.
on/off	Enables/disables each type of triggering.
Upper Limit	Set an upper limit to the true power factor (W/VA). If the power factor rises above this limit for the selected line group, a disturbance trigger occurs.
Lower Limit	Set a lower limit to the true power factor. If the power factor falls below this limit for the selected line group, a disturbance trigger occurs.

Rate of Change

Set a trigger on the variation of the power factor:

- *%* - sets how much the power factor must change.
- *Cycles* - sets the number of cycles over which this change must occur to cause a disturbance trigger.

For example if these are set to 10% over two cycles, there must be a 10 % variation within two cycles for the trigger to occur.

Displacement Power Factor

Upper Limit — Set an upper limit to the displacement power factor. If the displacement power factor rises above this limit for the selected line group, a trigger occurs.

Lower Limit — Set a lower limit to the displacement power factor. If the displacement power factor falls below this limit for the selected line group, a trigger occurs.

Rate of Change — Set a trigger on the variation of the displacement power factor:

- *%* - sets how much the displacement power factor must change.
- *Cycles* - sets the number of cycles over which this change must occur to cause a disturbance trigger.

For example if these are set to 10% over two cycles, there must be a 10 % variation within two cycles for the trigger to occur. Both positive and negative changes are detected.

Impedance Tab

Figure 2.83 shows the Impedance tab.

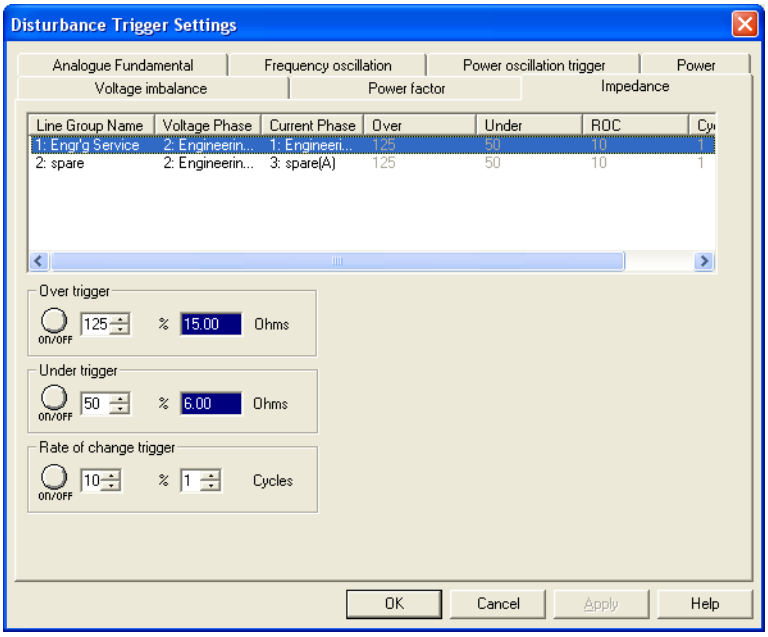

Figure 2.83 Disturbance Trigger Settings - Impedance Tab

Buttons and Fields

on/off	Enables/disables each type of triggering.
Line Group channel	Select a line group and the line group's impedance trigger settings appear below.
Over Trigger	Enter the percentage of the nominal impedance that the line group's impedance must exceed before an impedance trigger occurs. A *nominal* value is calculated and appears in the Ohms field for the line group's impedance from the nominal voltage and current of that group.
Under Trigger	Enter the percentage of the nominal impedance that the line group's impedance must dip below before an impedance trigger occurs. A *nominal* value is calculated and appears in the Ohms field for the line group's impedance from the nominal voltage and current of that group.

Rate of Change Trigger

Set a trigger on the variation of the impedance:

- *%* - sets how much the impedance must change.
- *Cycles* - sets the number of cycles over which this change must occur to cause a disturbance trigger.

Power Oscillation Tab

Figure 2.84 shows the Power Oscillation tab.

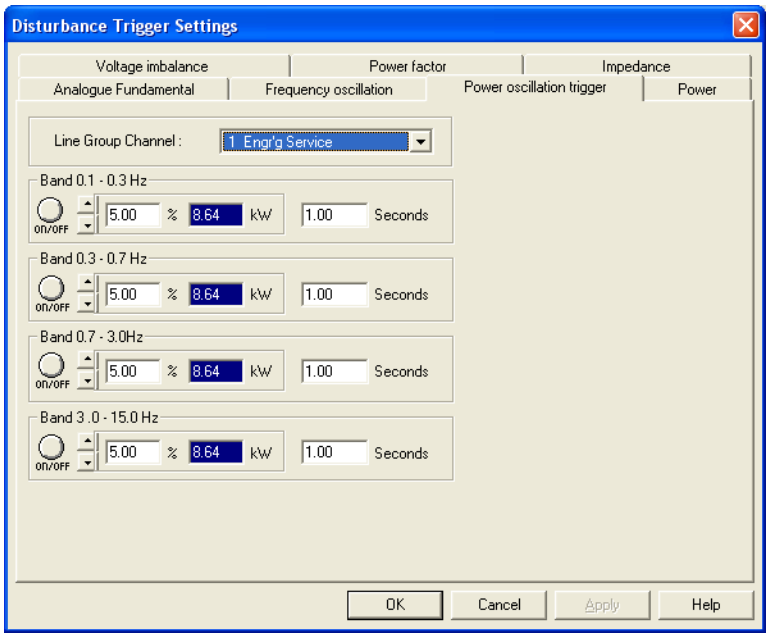

Figure 2.84 Disturbance Trigger Settings - Power Oscillation Tab

Buttons and Fields

on/off — Enables/disables each type of triggering.

Line Group Channel — Specifies the line group for triggering.

Band — For each line group there are four frequency bands within which triggers are set. Each band represents a different rate within which the real power may be changing.

% — Sets, for each band, a threshold of the power oscillation above which a trigger occurs.

Seconds — Enter a dwell time in seconds. This is the length of time for which the rate of change of power must remain above the threshold for a trigger to occur. This can be set to *0* if required.

Frequency Oscillation Tab

Figure 2.85 shows the Power tab.

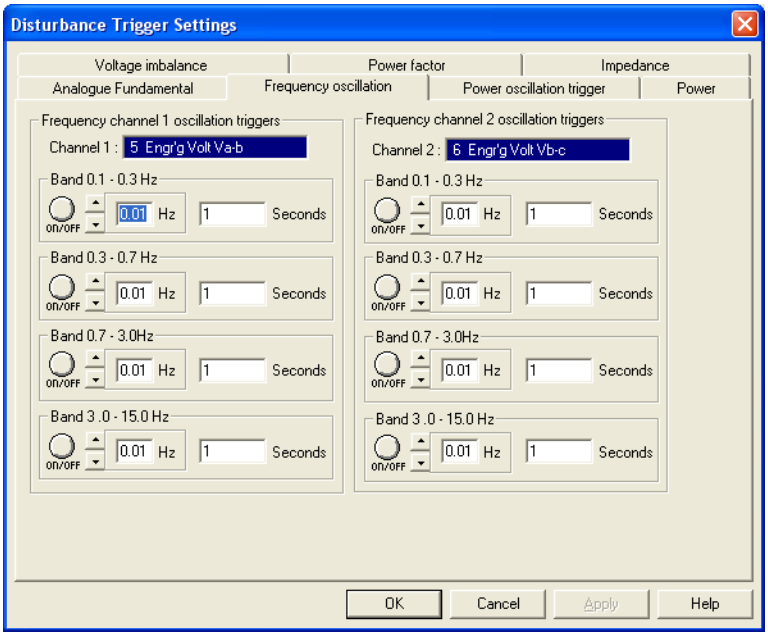

Figure 2.85 Disturbance Trigger Settings - Frequency Oscillation Tab

Buttons and Fields

on/off — Enables/disables each type of triggering.

Channel 1/Channel 2 — Displays frequency channels.

Band — For each frequency channel there are four bands within which triggers are set. Each band represents a different rate within which the frequency may be changing.

% — Sets, for each band, a threshold of the frequency oscillation above which is a trigger.

Seconds

Enter a dwell time in seconds. This is the length of time for which the rate of change of frequency must remain above the threshold for a trigger to occur. This can be set to 0 if required. Ensure that when setting this as a time constraint that it is at least one and a half times the period of the frequency band.

Analogue channel range (PM)

If the current configuration belongs to a pseudo recorder then oscillatory triggering for the two frequency channels can be set up for each individual recorder. Select the range of Analogue channels to pick from and then click on the required range.

Phase Difference (TR2000 with synchrophasor)

Figure 2.86 shows the Phase Difference tab.

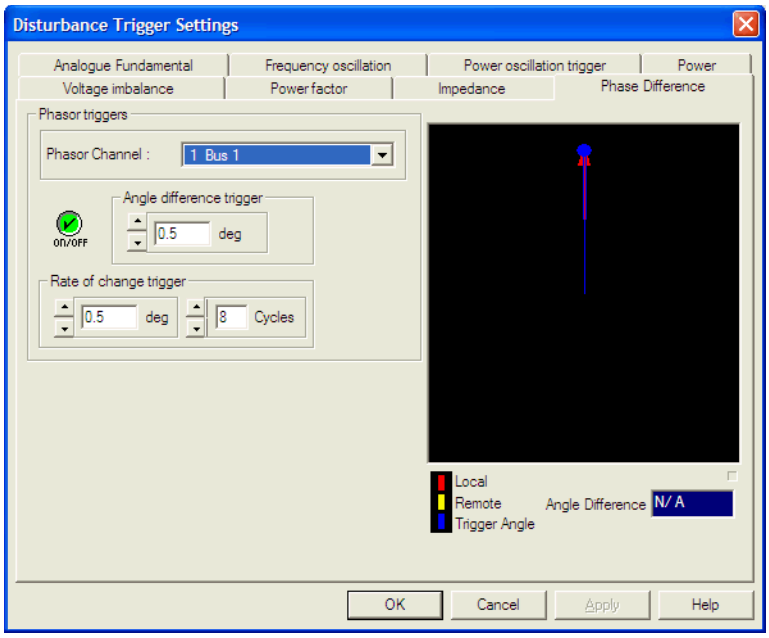

Figure 2.86 Disturbance Trigger Settings - Phase Difference Tab

Buttons and Fields

on/off

Enables/disables each type of triggering.

Phasor Channel Set the phase group to be used for a phase difference trigger.

Angle Difference Trigger

Set the phase difference angle at which the recorder triggers. The diagram to the right shows the angle being set in blue.

Rate Of Change Trigger

Set to make the recorder trigger on a change of angle over a number of cycles.

Phase angle difference

Set the number of cycles over which this phase difference must occur. Both positive and negative changes are detected.

If another TR2000 is currently configured for phasor measurement and connected, the phase angles of both recorders appear in the diagram.

Trigger Operations

Transient triggers

To configure the Transient triggers:

1. Click **Transient triggers** and the Trigger Settings dialog appears with the Analogue tab active (Figure 2.87).

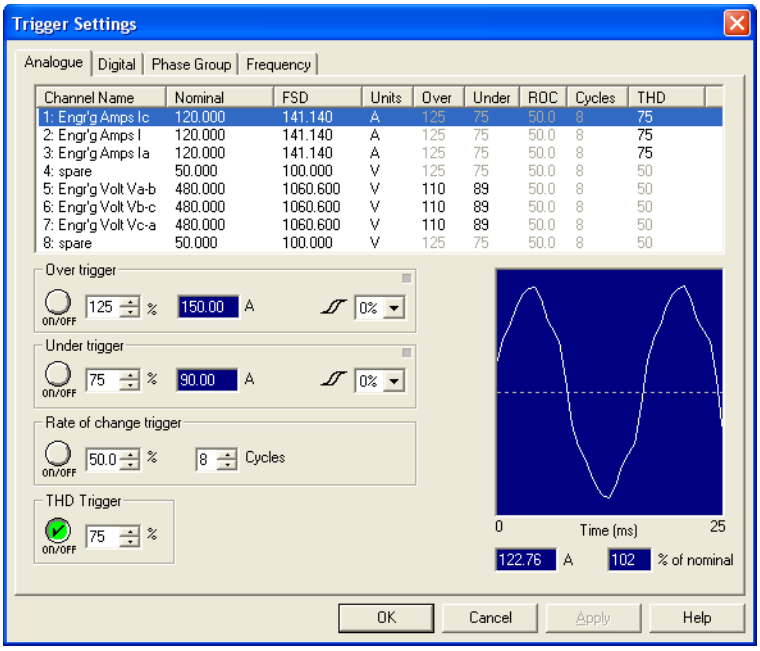

Figure 2.87 Trigger Settings - Analogue Tab

2. Configure the Analogue tab by (Figure 2.87):

a. Selecting a *Channel Name* in the display area.

b. Clicking **on/off** for Over trigger, using the spinner, or entering a value, to set an *Over trigger* percentage, then using the down spinner to set a hysteresis percentage.

c. Clicking **on/off** for Under trigger, using the spinner, or entering a value, to set an *Under trigge*r percentage, then using the down spinner to set a hysteresis percentage.

d. Clicking **on/off** for Rate of change trigger, and using the spinner, or entering a value, to set a Rate of change trigger percentage.

NOTE

Multiple channels can be selected and set simultaneously using the Shift or CTRL keys, if settings are the same.

3. Configure the Digital tab by (Figure 2.88):

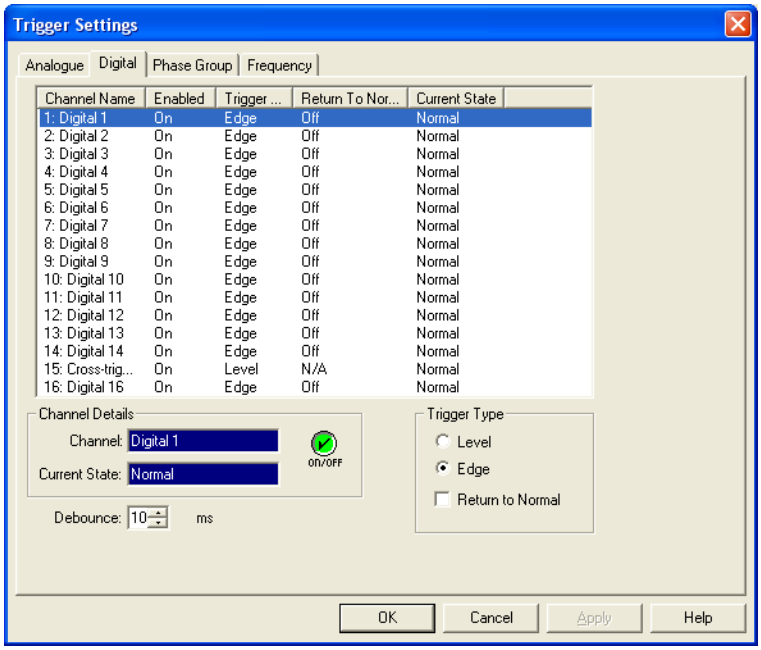

Figure 2.88 Trigger Settings - Digital Tab

a. Selecting a *Channel Name* in the display area.
b. Clicking **on/off** for Channel Details. The Channel and Currents State appear in their fields.
c. Clicking a **Trigger Type** radio button for Level or Edge.
d. Clicking the **Return to normal** check box, as required.
e. Using the spinner to enter a *Debounce time,* if required.

NOTE

Multiple channels can be selected and set simultaneously, if settings are the same.

4. Configure the Phase Group tab by (Figure 2.89):

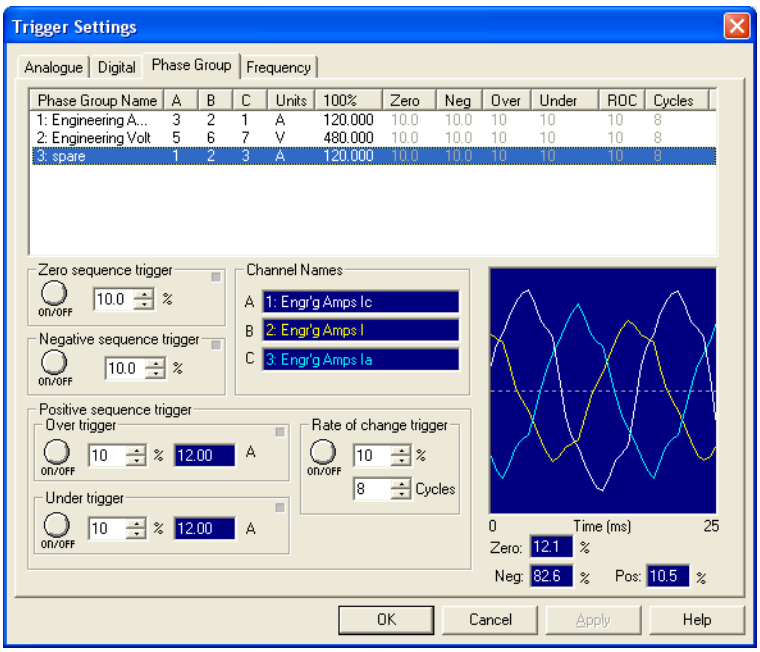

Figure 2.89 Trigger Settings - Phase Group Tab

a. Selecting a *Phase Group Name* in the display area.

b. Clicking **on/off** for Zero sequence trigger and using the spinner to set a *Zero sequence trigger* percentage.

c. Clicking **on/off** for Negative sequence trigger and using the spinner to set a *Negative sequence trigger* percentage.

d. Clicking **on/off** for Positive sequence trigger Over trigger and using the spinner to set an *Over trigger* percentage.

e. Clicking **on/off** for Positive sequence trigger Under trigger and using the spinner to set an *Under trigger* percentage.

f. Clicking **on/off** for Rate of change trigger, using the spinner to set a *Rate of change trigger* percentage and to set the *Cycles*.

5. Configure the Frequency tab by (Figure 2.90):

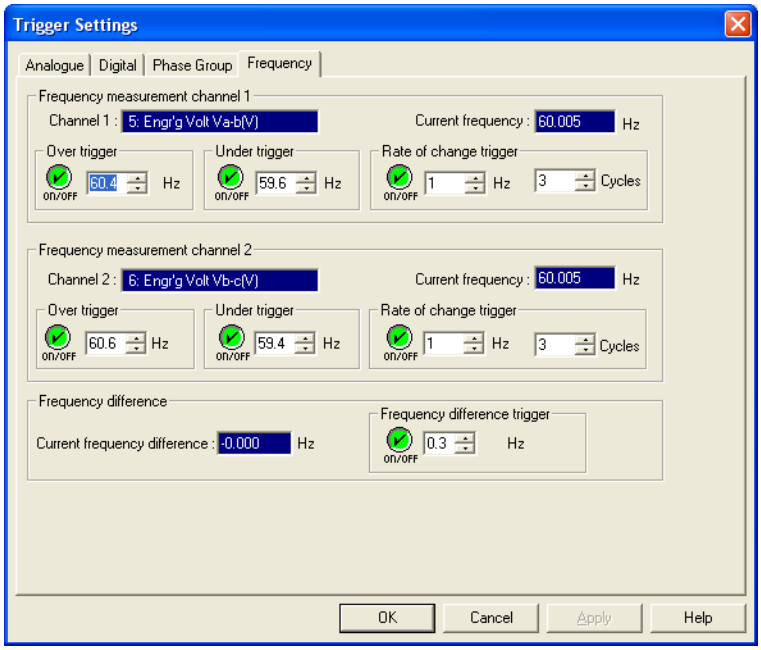

Figure 2.90 Trigger Settings - Frequency Tab

a. Clicking **on/off** for Frequency measurement channel 1 Over trigger and using the spinner to set a frequency value.
b. Clicking **on/off** for Frequency measurement channel 1Under trigger and using the spinner to set a frequency value.
c. Clicking **on/off** for Frequency measurement channel 1 Rate of change trigger, using the spinner to set a frequency and to set the *Cycles*.
d. Repeat a, b and c for Frequency measurement channel 2.
e. Clicking **on/off** for Frequency difference trigger and using the spinner to set a frequency.

6. Configure the External tab (Figure 2.91) by:

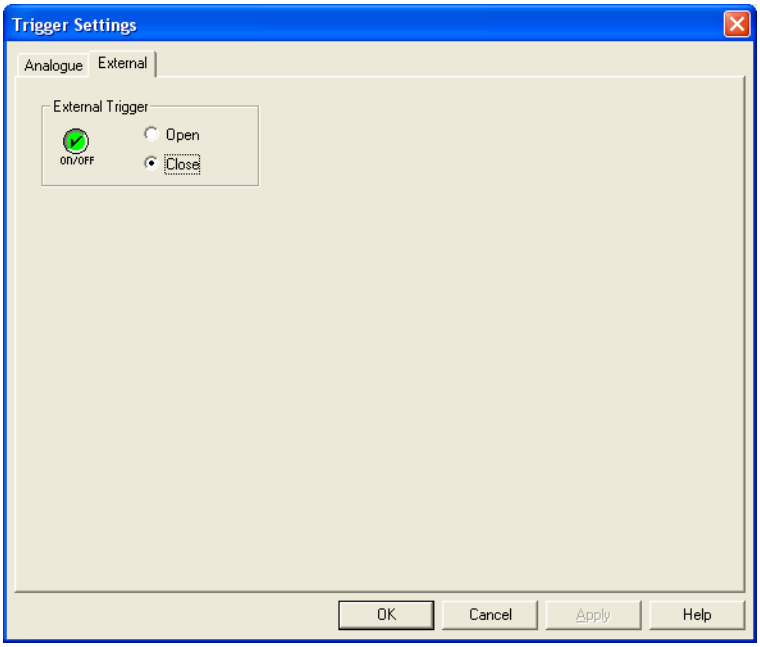

Figure 2.91 Trigger Settings - External Tab

a. Clicking **on/off** for External Trigger.

b. Clicking a radio button:

- **Open** - indicates an NO condition.
- **Closed** - indicates an NC condition.

7. Click **OK**.

Disturbance Triggers

Click on the Disturbance Triggers button to open the Disturbance Trigger Settings dialog for adjusting the conditions, which indicate a disturbance fault. (TR2000 only).

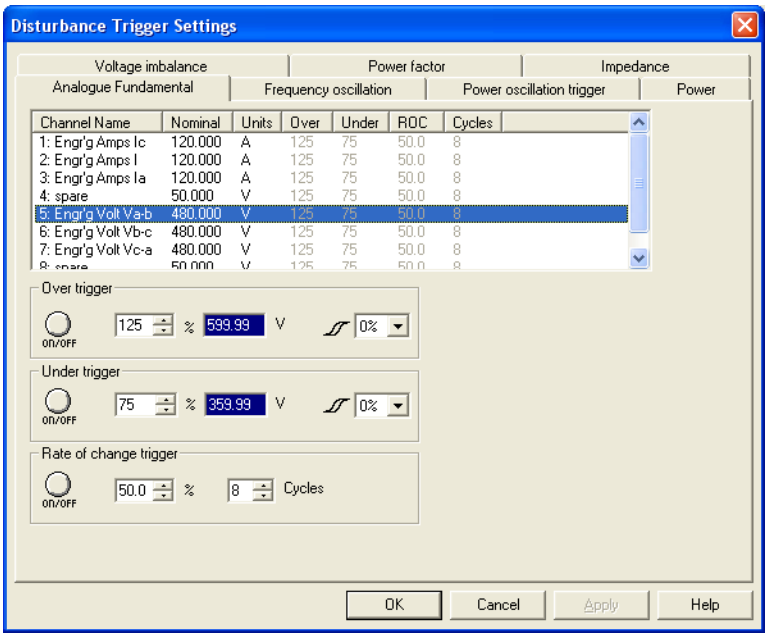

Figure 2.92 Disturbance Trigger Settings - Analogue Fundamental Tab

1. Configure the Analogue Fundamentals tab by (Figure 2.92):

a. Selecting a Channel Name in the display area.

b. Clicking **on/off** for Over trigger, using the spinner to set an *Over trigger* percentage, then using the down spinner to set a hysteresis percentage.

c. Clicking **on/off** for Under trigger, using the spinner to set an *Under trigger* percentage, then using the down spinner to set a hysteresis percentage.

d. Clicking **on/off** for Rate of change trigger, and using the spinner to set a *Rate of change trigger* percentage.

NOTE

Multiple channels can be selected and set simultaneously, if settings are the same.

2. Configure the Frequency Oscillation tab by (Figure 2.93):

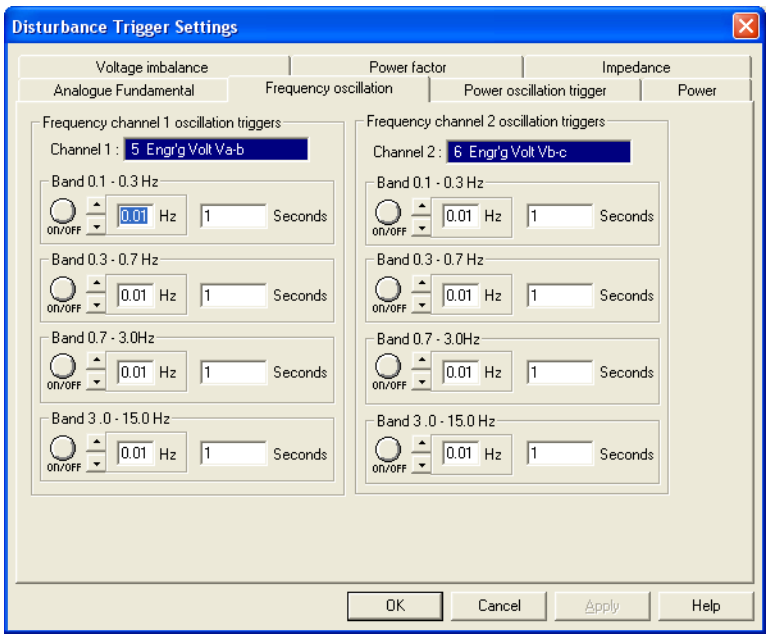

Figure 2.93 Disturbance Trigger Settings - Frequency Oscillation Tab

a. Clicking **on/off** for Frequency channel 1 oscillation triggers bands, using the spinners to set the frequency and entering a time in the field.

b. Repeat a for Frequency channel 2 oscillation triggers.

3. Configure the Power oscillation trigger tab by (Figure 2.94):

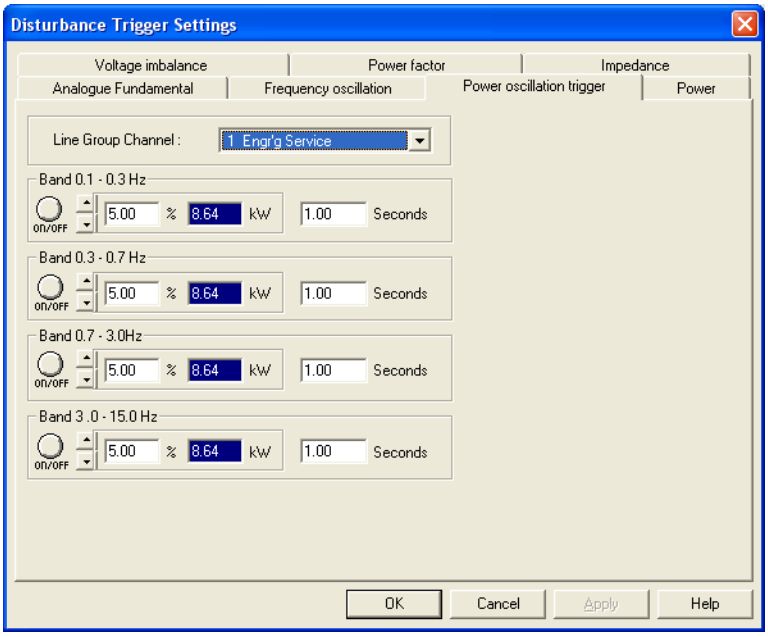

Figure 2.94 Disturbance Trigger Settings - Power Oscillation Tab

a. Using the spinners to select a *Line Group Channel*.

b. Clicking **on/off** for each band, using the spinners to set the power percentage and entering a time in the field.

4. Configure the Power tab by (Figure 2.95):

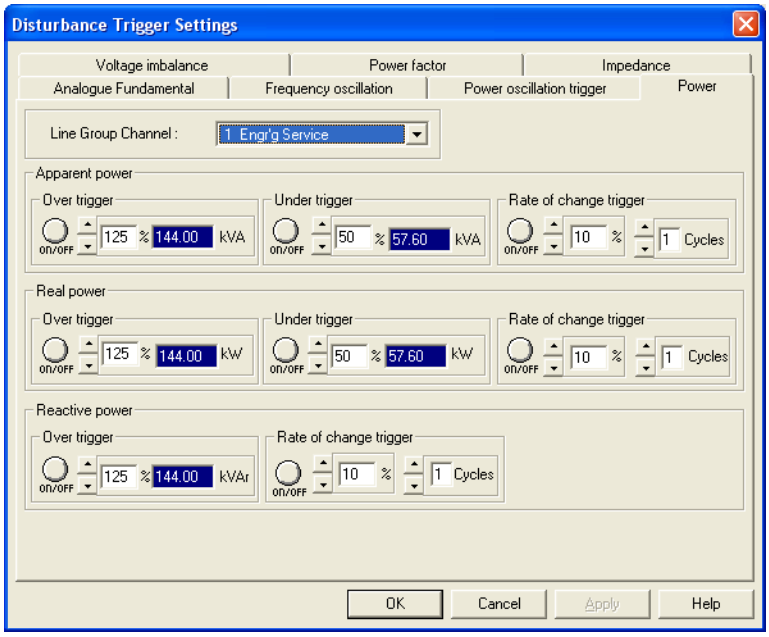

Figure 2.95 Disturbance Trigger Settings - Power Tab

a. Using the spinners to select a *Line Group Channel*.

b. Clicking **on/off** for Apparent power Over trigger and using the spinner to set an *Over trigger* percentage.

c. Clicking **on/off** for Apparent power Under trigger and using the spinner to set an *Under trigger* percentage.

d. Clicking **on/off** for Apparent power Rate of change trigger, using the spinner to set a *Rate of change trigger* percentage and the *Cycles*.

e. Repeat b, c and d for Real power.

f. Repeated and d for Reactive power.

5. Configure the Impedances tab by (Figure 2.96):

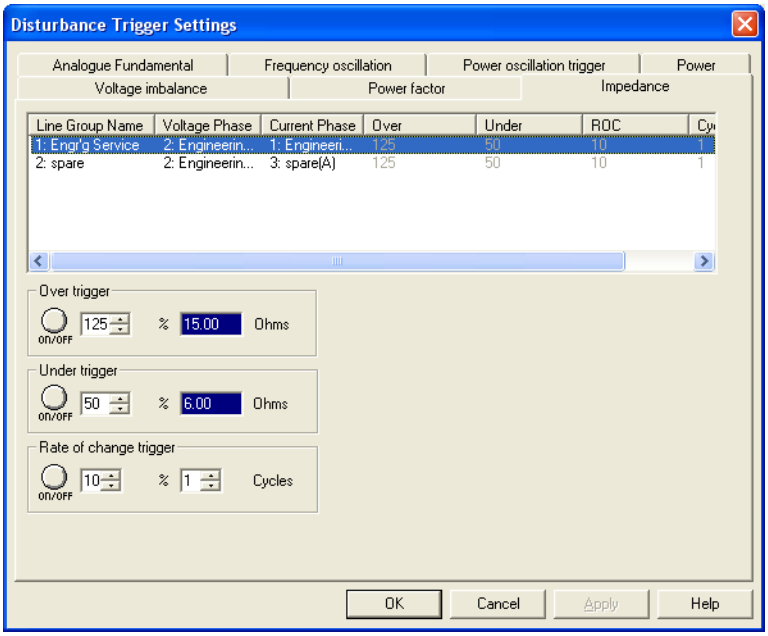

Figure 2.96 Disturbance Trigger Settings - Impedance Tab

a. Selecting a *Line Group Name* in the display area.

b. Clicking **on/off** for Over trigger and using the spinner to set an *Over trigger* percentage.

c. Clicking **on/off** for Under trigger and using the spinner to set an *Under trigger* percentage.

d. Clicking **on/off** for Rate of change trigger, and using the spinner to set a *Rate of change trigger* percentage and the *Cycles*.

6. Configure the *Power factor* tab by (Figure 2.97):

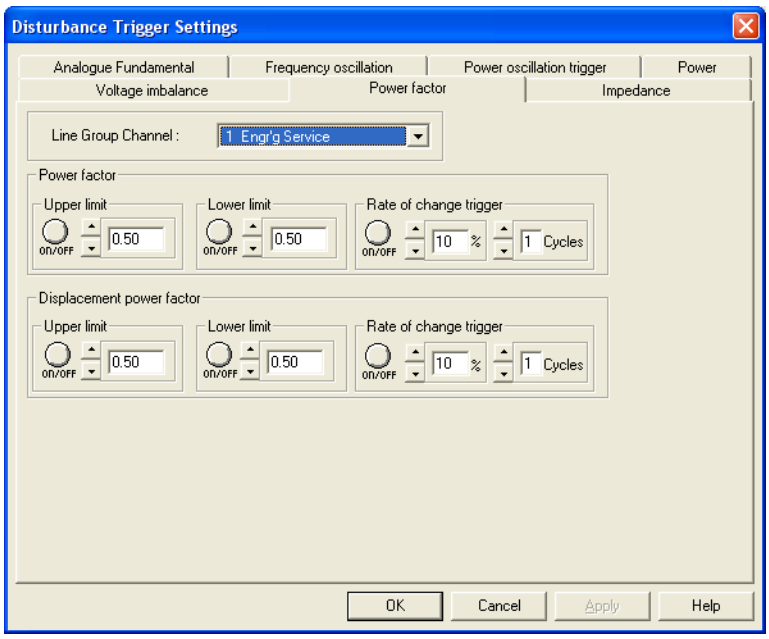

Figure 2.97 Disturbance Trigger Settings - Power Factor Tab

a. Using the spinners to select a *Line Group Channel.*
b. Clicking **on/off** for the Power factor Upper limit and using the spinners to set the power factor percentage.
c. Clicking **on/off** for the Power factor Lower limit and using the spinners to set the power factor percentage.
d. Clicking **on/off** for the Power factor Rate of change timer and using the spinners to set the trigger percentage and the *Cycles*.
e. Repeat b, c and d for the Displacement power factor.

7. Configure the *Voltage Imbalance* tab by (Figure 2.98):

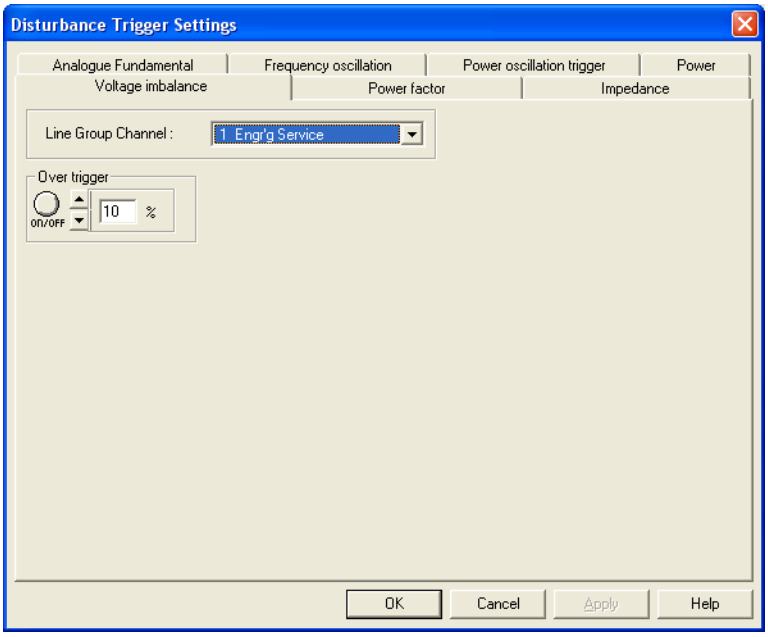

Figure 2.98 Disturbance Trigger Settings - Voltage Imbalance Tab

a. Using the spinners to select a *Line Group Channel*.

b. Clicking **on/off** for the Over trigger and using the spinners to set the trigger percentage.

8. Click **OK**.

Cross Triggering

Use this window (Figure 2.99) to set up the relationship between transient triggers and disturbance triggers. This is used for a number of functions including, extending the transient pre and post fault times using a disturbance record (TR2000 only).

Buttons and Fields

Transient trigger -> Disturbance trigger

Switch on and when a transient trigger causes a transient record to be generated, a disturbance record is generated. The disturbance record has the same Trigger Type as the transient record

Disturbance trigger -> Transient trigger

Switch on and when a disturbance trigger causes a disturbance record to be generated, a transient record is generated. The transient record has the same Trigger Type as the disturbance record.

Cross Triggering Operations

To configure cross triggering:

1. Click **Cross triggering** and the Cross triggering dialog appears (Figure 2.99).

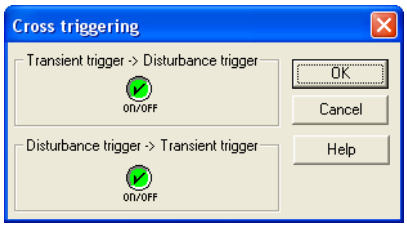

Figure 2.99 Cross Triggering

2. Click **on/off** for Transient trigger -> Disturbance trigger and/or Disturbance trigger -> Transient trigger.
3. Click **OK**.

Operating limits - Transient triggers (TR2000 only)

This window (Figure 2.100) sets a number of disturbance or transient triggers that can occur within a certain time span on any one particular channel.

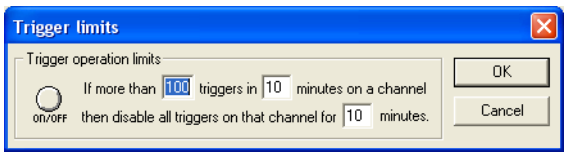

Figure 2.100 Trigger Limits

Operating limits - Transient triggers Operations

To configure this:

1. Click **Operating limits** and the Trigger limits dialog appears.
2. Click **on/off**.
3. Enter the maximum number of triggers that can occur.
4. Enter the time span in minutes for these triggers to occur.
5. Enter the length of time to disable triggering if the maximum number of triggers is reached within the time specified.
6. Click **OK**.

Real Time Display

Use this window (Figure 2.101) to view a combination of actual values and calculated values on a connected recorder. On a:

- TR100 recorder, analog and digital values only are available.
- TR2000, TR100+ and PQR, disturbance and power values are also available.

The values in the real time displays are updated approximately once a second, depending on the speed of the connection.

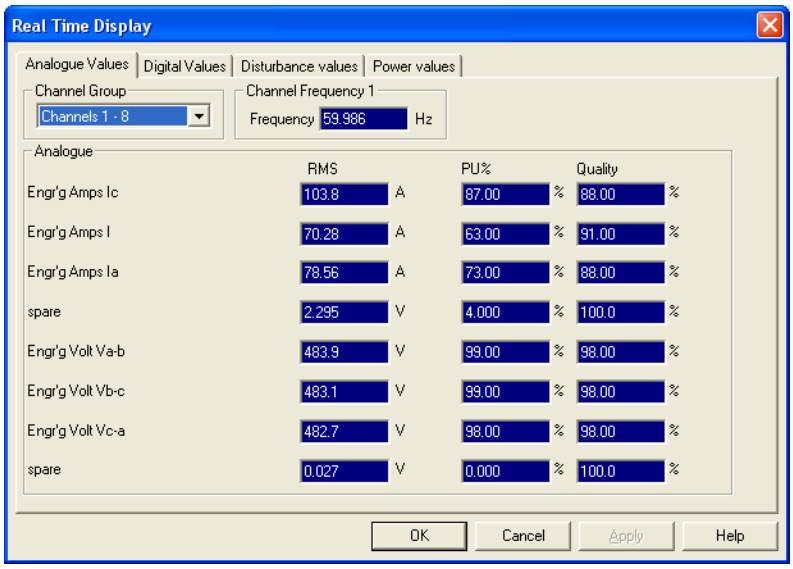

Figure 2.101 Real Time Display - Analogue Values Tab

There are up to five tabs:

- *Analog Values* - Displays the values being read on the connected recorder's analog channels.
- *Digital Values* (TR100, TR100+ & TR2000) - Displays the status of the recorder digital channels.
- *Disturbance Values* (TR2000, TR100+ & PQR) - Displays magnitude and phase information for each line group.
- *Power Values* (TR2000, TR100+ & PQR) - Displays the values calculated for power on each line group.
- *Energy Meters* (PQR) - Displays the accumulating energy meters.

Analog Values Tab

Buttons and Fields

Channels	Select a range of channels to view. Channels 1-8, 9-16,17-24, and 25-32 are available, although the latter three depend on the channel size of the recorder. If a Pseudo Machine is viewed, many more channels may be available.
Frequency	Displays the frequency being recorded on the defined frequency channel. For a TR2000 this is Frequency Channel 1.
Analog	Displays the analog channels and their current values. The label of each configured channel appears on the left.
RMS	Shows the true RMS value of each analog channel.
PU%	Shows the PU (Per Unit) value of each analog channel, expressed as a percentage of the set nominal value.
Quality	Displays a measure of the harmonic distortion of each channel. The value shown is a percentage difference between the input signal and a perfect sine wave. Do not confuse this with total harmonic distortion (THD).

Digital Values Tab (TR100, TR100+ & TR2000)

Figure 2.102 shows the Digital Values tab.

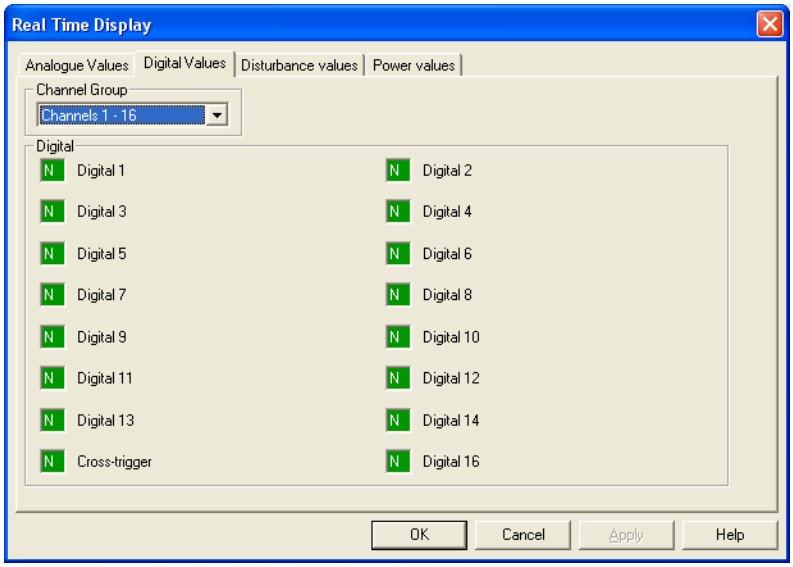

Figure 2.102 Real Time Display - Digital Values Tab

Buttons and Fields

Channels — Select the channels to show i.e. channels 1 – 16, 17 – 32, 33 - 48 or channels 49 – 64. The maximum number of channels available depends on the connected recorder. If a Pseudo Machine is viewed, many more channels may be available.

Digitals — The values of the digital channels being monitored appear. Channels in the:

- Normal state appear with a green background and the letter N (Normal).
- Alarm state appear with a red background and the letter A (Alarm).

Disturbance Values (TR2000, TR100+ & PQR) Tab

Figure 2.103 shows the Disturbance Values tab.

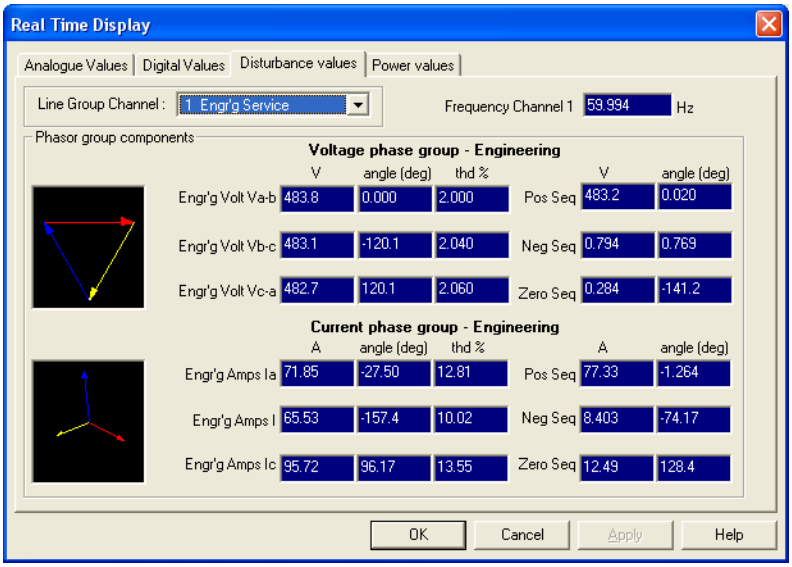

Figure 2.103 Real Time Display - Disturbance Values Tab

Buttons and Fields

Line Group Channel

Select the line group to view and the values currently being recorded and calculated appear. There is only one line group in a PQR.

Frequency Channel Displays the frequency channel measurement for the selected line group.

Phasor group components

Voltage phase group

Displays the voltages measured for the line group. For the three phase inputs the fundamental frequency magnitude, angle and total harmonic distortion (as a percentage) appear. Further to the right, the sequence components appear: positive, negative and zero sequence, the resultant magnitude in rms and angle appear.

Current phase group

Displays the currents measured for the line group. For the three phase inputs the fundamental frequency magnitude, angle and total harmonic distortion (as a percentage) appear. Further to the right, the sequence components appear: positive, negative and zero sequence, the resultant magnitude in rms and angle appear.

Phasor Diagrams Display the relationship between the three phases for both voltage and current. All angles are relative to the first voltage channel. If the voltage phase group has been defined as phase-to-phase the vectors are shown as a triangle.

Power Values Tab (TR2000, TR100+ & PQR)

Figure 2.104 shows the Power Values tab.

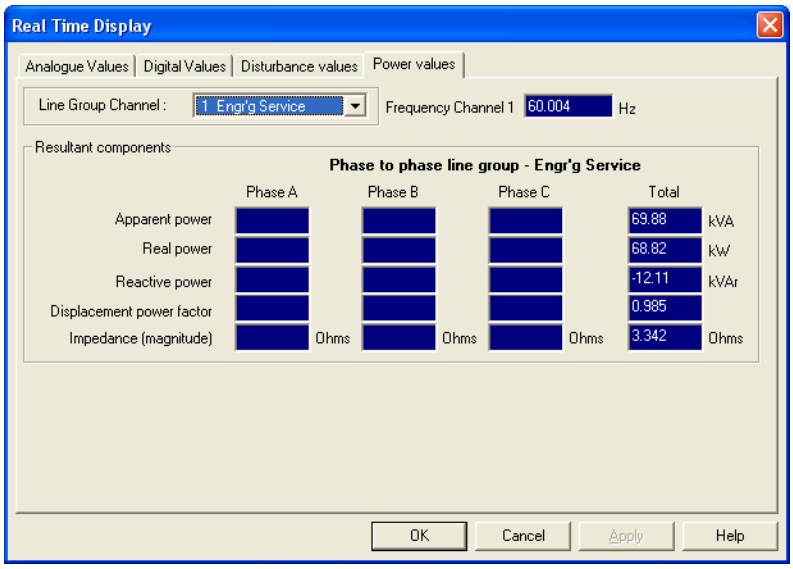

Figure 2.104 Real Time Display - Power Values Tab

Buttons and Fields

Line Group Channel

Select a line group to view. There is only one line group in a PQR.

Frequency Channel Displays the frequency channel value for the selected line group.

Resultant Components

Phases — Displays, for each phase, the apparent power, real power, reactive power, displacement power factor and impedance.

Total — Displays the circuit totals of each of these quantities. If the VT phase group is defined as P-P then only total power appears.

Metered Power Tab (PQR)

When a recorder is connected this gives on-line displays of *live* data from its input channels.

Figure 2.105 shows the Metered power tab.

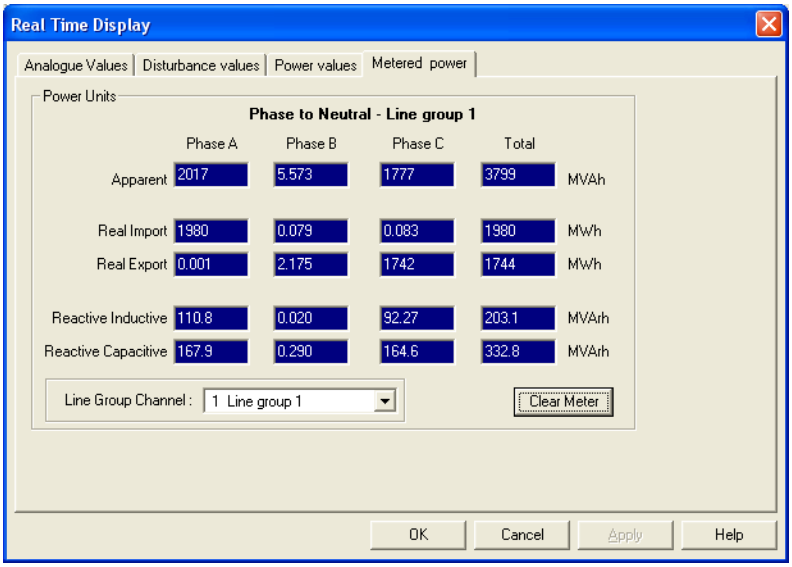

Figure 2.105 Real Time Display - Metered Power Tab

Buttons and Fields

Line Group Channel

Select a line group to view. There is only one line group in a PQR.

Resultant Components

Phases — Displays, for each phase, the apparent power, real import power, real export power, reactive inductance and capacitance.

Total	Displays the total circuit apparent energy, imported and exported real energy, inductive and capacitive reactive energy per phase. If the VT phase group is defined as P-P then only total power appears.
Clear Meter	Resets all the registers.

Real Time Display Operations

To use the real time display:

1. Click **RealTimeDisplay** and the Real Time Display window appears (Figure 2.106).

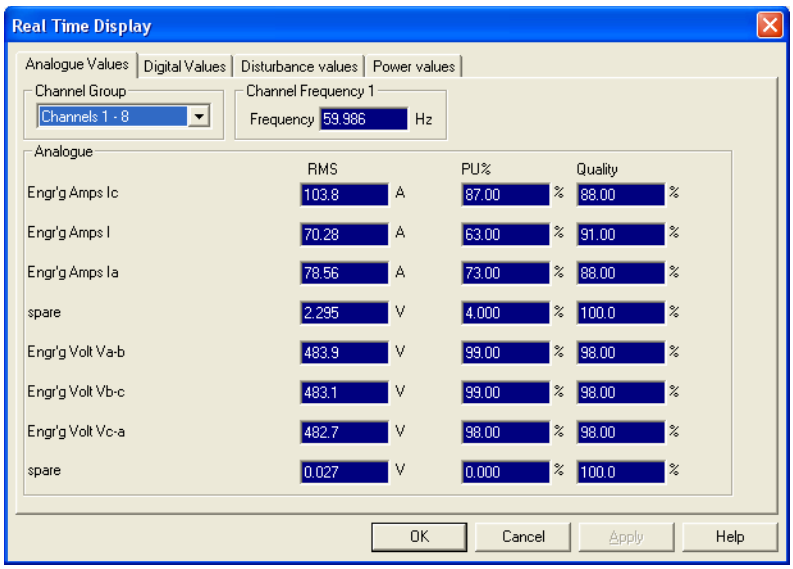

Figure 2.106 Real Time Display - Analogue Values Tab

2. Use the spinner to select a:
   - *Channel Group* for the Analogue Values and Digital Values tabs or,
   - *Line Group Channel* for the Disturbance values or Power values tabs.
3. Click **OK**.
4. Click **Cancel** to close the display.

View Configuration File

Use this window (Figure 2.107) to view the complete configuration of the recorder in a basic text format.

CAUTION

Do not edit or alter this file.

To view the configuration file (Figure 2.107):

- Click **View configuration file**.

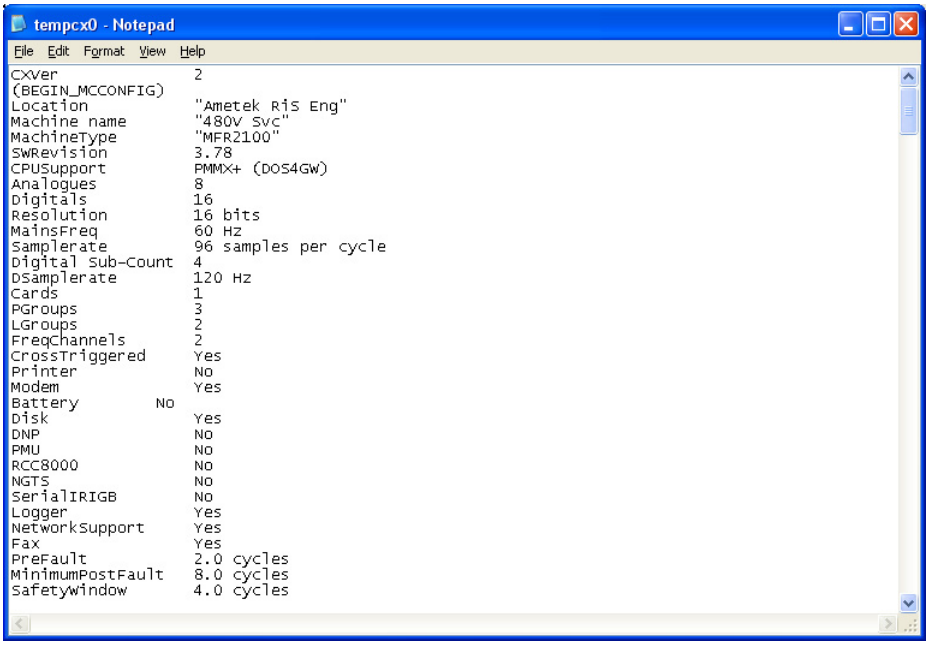

Figure 2.107 Configuration File

PQR Set up Wizard (PQR)

Use this wizard (Figure 2.108) to quickly configure a PQR recorder. The wizard creates names for each channel and sets the nominal and full-scale values for each channel. Once the set-up wizard has been used to configure a recorder, the configuration can be viewed and edited in the normal way using the Recorder - Configure option.

The wizard also provides a real time input check facility that lets you confirm that the inputs to the recorder are wired correctly.

A PQR recorder must be connected to DS32 before the wizard appears in the menu. The wizard runs a sequence of screens to enter simple information about interposing transformers, triggering and communication peripherals.

PQR Set-up Wizard Operations

To use the PQR Set-up Wizard:

1. Select *Recorder > PQR Set-up Wizard.*

The PQR Set-up Wizard - Recorder Identification dialog appears (Figure 2.108).

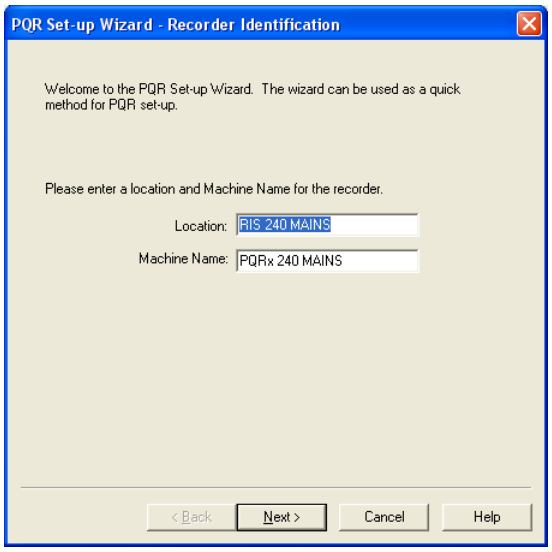

Figure 2.108 PQR Set-up Wizard - Recorder Identification

2. Enter a *Location* and a *Machine Name* and click **Next** and the Voltage Channel Setup dialog appears (Figure 2.109).

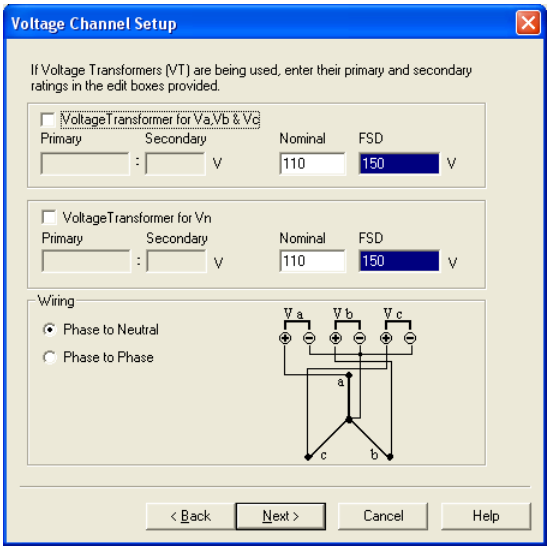

Figure 2.109 Voltage Channel Setup

3. Click the **Voltage Transformer for Va, Vb & Vc,** enter *Primary, Secondary,* and *Nominal* values, if required.
4. Click the **Voltage Transformer for Vn**, enter *Primary, Secondary,* and *Nominal* values, if required.

NOTE

If values in the fields in the two steps above conflict an error dialog appears asking you to confirm your selections.

5. Click either the **Wiring Phase to Neutral or phase-to-phase** radio button and click **Next**.

   The Current Channel Setup dialog appears (Figure 2.110).

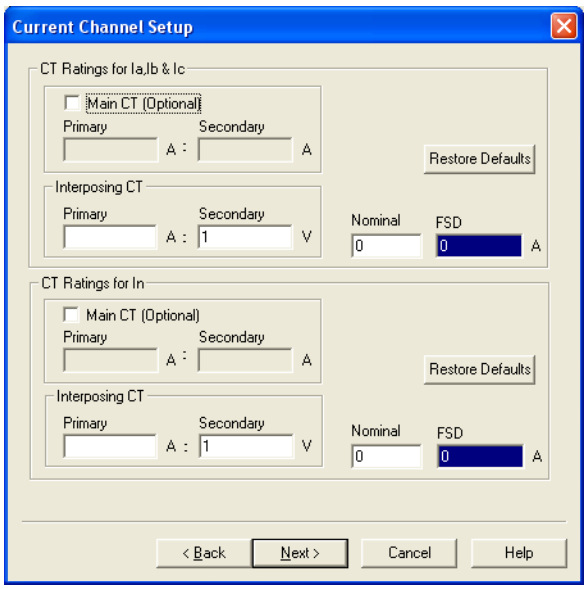

Figure 2.110 Current Channel Setup

6. Click the **Main CT (optional)** check box in CT Ratings for Ia, Ib & Ic, if required, and enter *Primary* and *Secondary* values.
7. Enter *Interposing CT Primary, Secondary* and *Nominal* values, if required.
8. Click the **Main CT (optional)** check box in CT Ratings for In, if required, and enter *Primary* and *Secondary* values.
9. Enter *Interposing CT Primary, Secondary* and *Nominal* values, if required and click **Next**.

The PQR Input Check dialog appears (Figure 2.111).

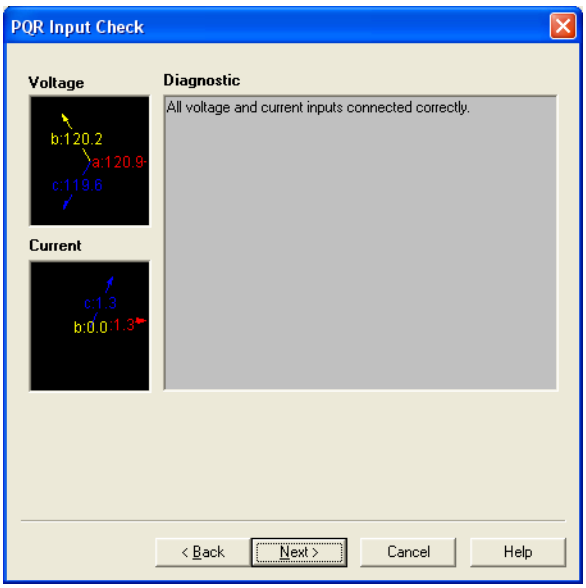

Figure 2.111 PQR Input Check

10. Wait until the message in the Diagnostic field reads as in Figure 2.111 and click **Next**.

The PQR Set-up Wizard Triggering dialog appears (Figure 2.112).

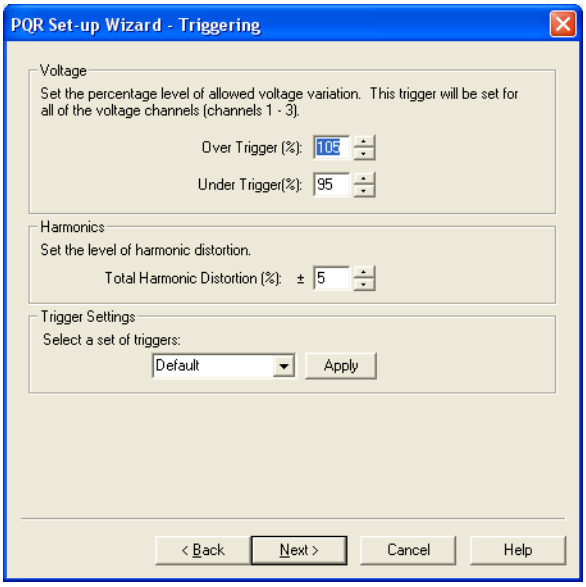

Figure 2.112 PQR Set-up Wizard Triggering

11. Use the spinners to set the *Over Trigger, Under Trigger* and T*otal Harmonic Distortion* percentages.

12. Use the spinner to select a trigger set and click **Apply**.

13. Click **Next**.

The PQR Modem dialog appears (Figure 2.113).

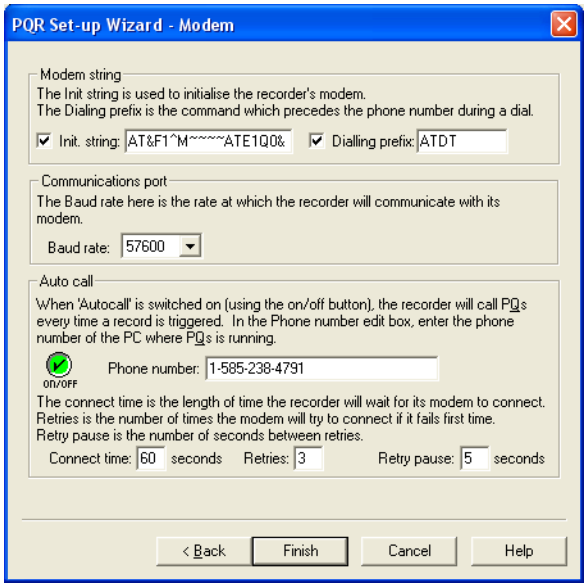

Figure 2.113 PQR Modem

14. Click the **Init. String** and **Dialog Prefix** check boxes and enter values in the associated fields, if required.

15. Use the spinner to set the *Baud Rate*.

16. Click **on/off** for Auto call and enter a *Phone Number*.

17. Enter values in the *Connect Time, Retires* and *Retry pause* fields and click **Finish**.

A dialog appears asking if you want to overwrite any previous PQR setup.

18. Click **Yes**.

Button and Fields

Recorder Identification

Location/Machine Identification

Enter the Location and Machine Name used to uniquely identify the recorder. Each name can have up to 24 characters.

Voltage Channel Setup

This dialog can be used to define the ratio of an interposing VT. The PQR has a maximum input of 150V, 300V or 600V rms. The wizard reads this value from the PQR and shows it as the default full-scale value (FSD). If a Voltage Transformer (VT) is not being used, then these default values for nominal and FSD are used. The nominal voltage can be edited, if required.

Voltage Transformers

Click on the Voltage Transformer check box if a VT is in use to step down a higher voltage for the recorder.

Primary/Secondary Enter the primary and secondary ratings for the VT. The wizard automatically works out and displays the nominal and FSD for the phase voltage inputs.

Nominal/FSD Set these for the phase channels (a, b & c) and individually for the neutral channel (n).

Wiring Set the VT wiring as Phase to Phase (P-P) or Phase to Neutral (P-N). A diagram shows how to connect the recorder's voltage inputs for each of these methods. The wizard names the voltage channels and voltage phase group automatically; e.g. Channel 1 is called Va, Channel 2 is Vb, etc.

Current Channel Setup

Use this dialog to define the ratios of primary and interposing current transformers (CT).

The PQR can be fitted with an internal shunt resistor. If a shunt is fitted, then the interposing Current Transformer (CT) must have a current output, otherwise it must have a voltage output. The PQR wizard knows if a shunt is fitted and change the units for the secondary rating of the interposing CT accordingly. The full-scale input for the PQR is 1.414V rms, which gives ~40% overrange for a 1V output clamp CT.

CT Ratings

Nominal/FSD Enter the nominal and FSD values.

Primary/Secondary Enter the ratings of the interposing CT.

Main CT Activate the check box and enter the primary and secondary ratings for the main CT. The nominal and FSD are calculated automatically when all the values are entered.

The Current Channel Setup part of the wizard names the current channels and current phase group automatically. Channel 5 is called Ia, channel 6 – Ib etc.

PQR Input Check

This dialog provides real time information on the inputs of the currently connected PQR. For this to operate correctly all three phase voltages and currents must be connected to the PQR.

Phasor Displays The two phasor displays show the magnitude and phase angle of each channel for both the current and voltage inputs. The input check does a number of diagnostic checks on this input and shows any errors along with the actions necessary to correct them in the diagnostic window.

The checks performed are as follows:

1 - Magnitude of the Voltage and Current Phasors are compared with the nominal values for each channel.

2 - The magnitudes of the three vectors within a phase group should be roughly the same.

	3 - The angle between phases should be approximately 120 degrees. 4 - The vectors of each phase should be in positive sequence order; i.e. a -> b -> c 5 - Angle between equivalent Voltage and Current phases should be roughly the same.
Triggering	
	Use this dialog to set up the triggering for the voltage channels. Each trigger set is applied to all the phase voltage channels.
Voltage	
Over Trigger	Set to the percentage of the nominal that the phase voltages must exceed in order to cause a Voltage Over Trigger.
Under Trigger	Set to the percentage of the nominal, which the phase voltages must drop below in order to cause a Voltage Under Trigger.
Harmonics	Set to a value that causes a THD trigger on the phase voltages.
Trigger Settings	Stores sets of triggers for all the above. Select a value from the drop down and click Apply to set the triggers to the pre-defined values.
Peripherals	Depending on the communications options reported by the PQR two different dialogs are available. For systems fitted with a modem or a network card a number of parameters are set.
Modem	Use this to set up a modem-to-modem connection between recorder and PC. Several parameters must be set. **Normally these values are set at the factory and should not be changed**.
Modem string	These values are critical to the correct operation of the modem and should only be changed by an experienced person.
Init String	Click the check box and enter an initialization string for the modem. The character *^M* translates to an ASCII carriage return and ~ translates to a half second delay (entered between commands).

Dialing Prefix — Click the check box and enter the string that precedes the phone number while dialing for the modem in use.

Communications port

This value controls the rate that the PQR talks to the modem (DTE rate).

Baud rate — Set to 57600 baud to maximize the communications speed.

Auto-call — Switch on and the recorder automatically calls the PC when a new fault is recorded. Enter the phone number to dial in.

Auto-call parameters

Connect time — Enter the amount of time a recorder waits for a call to be answered (range 3 – 300).

Retry pause — Enter the length of time between the end of one dial attempt and the start of the next (range 0 – 999).

Retries — Enter the number of times a recorder tries to connect to a PC before giving up (range 0 – 99).

Network — Displays the connection parameters of a recorder when it is connected over a TCP/IP network. If the correct values for these parameters are not known, consult with the relevant IT department.

Network Parameters

IP Address, IP Subnet Mask and Router IP Addr

Enter these values so the recorder has a unique identity on the network. These parameters can only be changed when the recorder is connected to the PC directly using an RS232 cable.

Event Log

The window (Figure 2.114) is a list of internal event and alarm messages held in the TR-100, 2000, 100+ and PQR battery backed memory. Available while the recorder is connected

To view the log:

- Select *Recorder > Event Log* and the log appears (Figure 2.114).

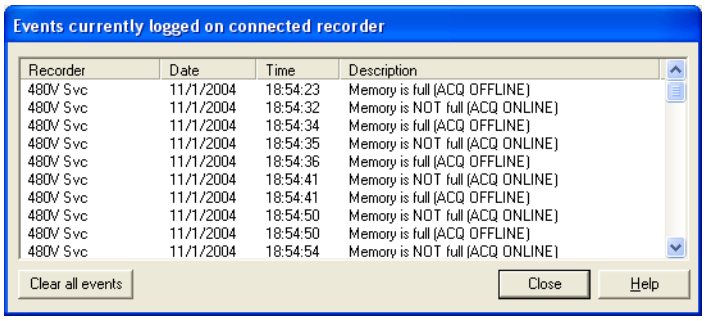

Figure 2.114 Event Log

When this is done a copy is automatically made at Display Station for viewing off line using View - Event Log. The events that are saved are:

- When the system is switched on and off.
- When the main supply is removed (battery option).
- When the memory is full (stop mode).
- When the disk is 85% full (disk option).
- When the system parameters are updated.
- When the Test button is pressed.
- If the modem does not initialize properly
- If the auto-call process failed
- If the printer is off line or out of paper.
- If the data buffers fill
- If clock sync or GPS is lost
- CPU watchdog
- Acquisition watchdog

Buttons and Fields

Clear all events — Clears the event log at the recorder of all events. Level 2 security is required to do this.

Manual Trigger

Use this dialog, while connected to a TR100, TR100+, PQR or a TR2000, to generate a short test record using a manual trigger. If connected to a:

- TR100 only a transient trigger is available.
- TR2000, TR100+ or PQR is connected then transient or disturbance records are available.

The record created by a manual trigger has a minimum post fault period and the Trigger type is Manual. This record can be downloaded and displayed to check that all the recording and communications functions are operating correctly.

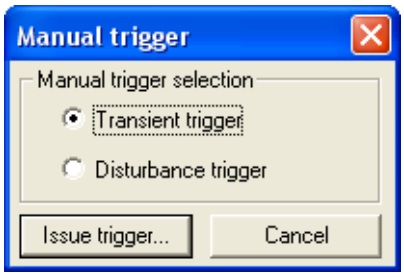

Figure 2.115 Manual Trigger

Manual Trigger Operations

To use a manual trigger:

1. Select *Manual trigger* and the Manual trigger dialog appears (Figure 2.115).
2. Click either the **Transient trigger** or **Disturbance trigger** radio button.
3. Click **Issue trigger**.

Transient Record Download

Use this option to manually recover selected transient records from the connected recorder. The process is implemented in two stages:

- The first is to recover a listing of records available
- Then a final selection is made of required files.

There are a number of options available to control the directory listing.

Buttons and Fields

New Records — Select New Records (Figure 2.118 on page 2-149) and only records that have not been marked as read by Display Station appear.

NOTE

If more than one version of Display Station is in use in a region this option may not show all unread records since they may have been read by another PC running Display Station.
There is no way to specify master or slave mode during installation. To configure slave mode after installation, add a line to the ds32.ini entry *SlaveMode=1* to the DS section.

All Records — Select this and the directory listing includes all the records held at the recorder. This could be a large number if the system has a hard disk.

Latest — Recovers a list of the most recent number of records specified.

Records since — Recovers a list of all records created after a specific date. This may be the date of the last connection to the recorder.

Include Profile information

Download the analog and digital profile information for each record with the directory. This makes the transfer time longer but the profile data is available immediately. If this is not done, each profile has to be fetched individually on request.

Transient Records Directory (Figure 2.119 on page 2-149)

This window lists the headers of all the records that were requested for download in the Transient Record Selection window. All records appear by date and time and those records that have not been previously copied to the Display Station have a tick in the New column.

Each record header is transferred to the Display Station with its profile (if selected) which contains the signal levels before, during and after the trigger, the maximum and minimum values during the record (Analog profile) as well as the contact transition times (Digital profile). These data are viewed by double clicking on the record entry.

Fault Data — Shows if the data is available on the recorder or whether it has been overwritten.

Action

Tells Display Station 32 what to do with the records listed. To set the value of this field, see the Right Click and Double Click sections below. There are four possible values, each of which refers to what Display Station 32 does with the record when Continue is clicked:

- Ignore - Nothing is done with the record (default). The event is marked as read, if Continue is clicked.
- Fault data - The record's fault data is downloaded
- Profile - The record's profile is downloaded
- Reduced - Reduced data is downloaded for the record (as set up in Record reduction parameters)

Clear All Records

Deletes *ALL* the transient records on the connected recorder.

Reduction Parameters

Opens the Record Transfer Options window, which is used to reduce the data being downloaded for the selected record.

Right Click

Position the mouse over a record in the list and right-click and a popup menu appears. This menu has several options that can be used to manipulate and view the record. Four of the options are used to set the Action column, i.e. Ignore, Mark fault data, Mark profile only and Reduced fault data, when selected set the Action column to Ignore, Fault data, Profile and Reduced (TR2000, and TR100+ only) respectively.

If the profile flag has been set in the Transient Record Selection window then three more options are available, for viewing the profile. These are:

- Analogs - Selecting analogs brings up the Analog Fault Levels – RMS window showing a summary of RMS levels one each channel before, during and after a fault.
- Digitals - Selecting Digitals brings up the Digital Transitions window, showing digital transitions during the fault. If Digital input 15 is used for cross triggering transitions on this input are not reported.
- Cameo - Selecting Cameo downloads the record in cameo form, and shows the record in the Cameo record window.

Double Click

Double-clicking on a record brings up the Record window (Figure 2.116), which shows the record's header information and gives options for viewing and manipulating the record.

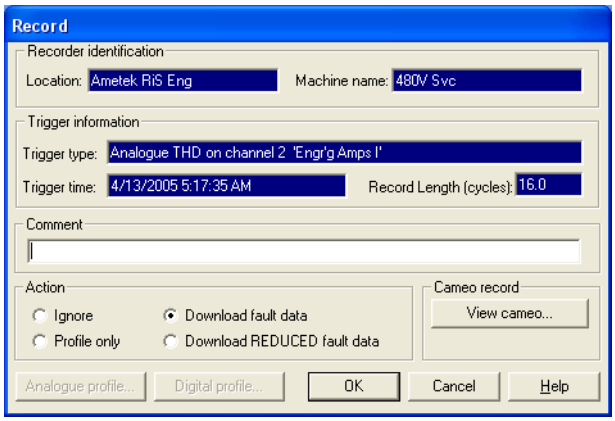

Figure 2.116 Record with Cameo Function

This window displays header information of whichever record was selected in the Transient Records window and allows cameo data, analog profile data and digital transition data to be viewed.

Recorder Identification

Displays the location and machine name of the selected recorder.

Trigger Information

Trigger type — Display what caused the trigger.

Trigger Time — Displays the date and time at which the trigger occurred, to the nearest millisecond.

Record Length — Displays the number of cycles in the whole record.

Comment — Enter a comment pertaining to the record.

Action — Specifies what information is required for the selected record. The option selected here is shown in the Action column of the Transient Records window.

Cameo record

View Cameo — Downloads the record in cameo form, and shows it in the Cameo record window (Figure 2.117). The Cameo is an RMS version of the waveform data.

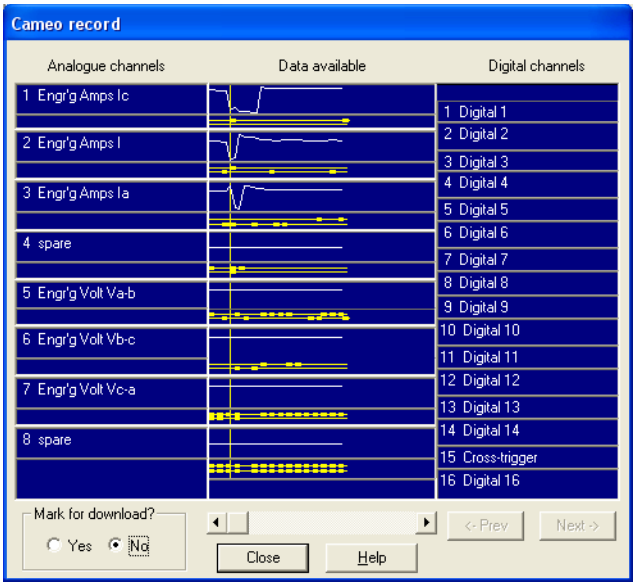

Figure 2.117 Cameo Record

Analogs — Opens the Analog Fault Levels – RMS window showing a summary of RMS levels on each channel before, during and after a fault.

Digitals — Opens the Digital Transitions window, showing digital transitions during the record. The transition times are relative to the trigger point.

Analog Profile

Displays the RMS levels of the cycles immediately before and after the start and end of the trigger condition. The maximum and minimum values throughout the duration of the record are also included.

The fault duration is the time in ms, between the start and end of the trigger condition. For a digital edge or manual trigger this value is zero.

This information is used to give an indication of the type and level of a line fault without having sight of the complete graphical record.

Digital Transitions — Displays the transition times of digital inputs that have profiling enabled. These times are relative to the trigger point. The fault duration is defined as the time from the start of the first trigger to the end of the last trigger (which may not be on the same channel or of the same type as the initial trigger).

Both analog and digital profiles are the same as those displayed on a printed record. These windows are also available in Display Station Analysis.

Transient Record Download Operations

To retrieve transient records:

1. Select **Transient Records** and the Record selection dialog appears (Figure 2.118).

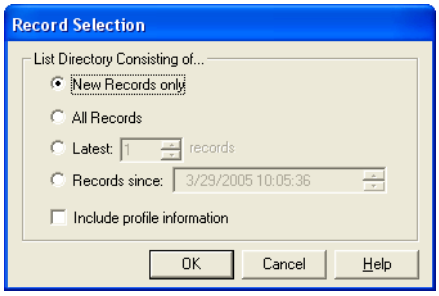

Figure 2.118 Record Selection

2. Click the radio button associated with the record range required. For:
   - **New Records only**- selects only records not previously downloaded
   - **All Records** - selects all records
   - **Latest** - use the spinner to select the number of records
   - **Records since** - use the spinner to select the record start date
3. Click the **Include profile information** check box to download the profile data for the records, if required.
4. Click **OK**.

   The Transient records available on connected recorder dialog appears (Figure 2.119).

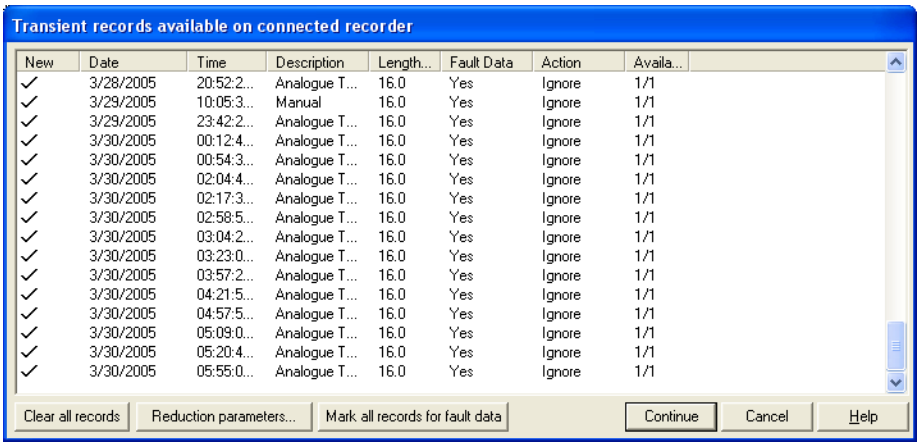

Figure 2.119 Transient Records Available

5. Click **Reduction parameters** to download reduced records (Figure 2.120).

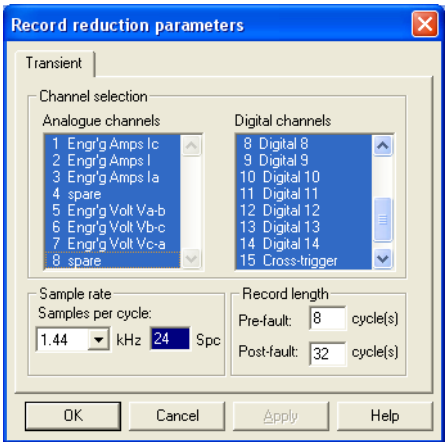

Figure 2.120 Record Reduction Parameters

6. Configure parameters on the dialog as required and click **OK**.

   The Transient records available on connected recorder dialog reappears.

7. Click **Mark all records for fault data** to download all associated fault data. Alternatively, right-click or double-click on a record to download.

8. Click **Continue** and the records are downloaded.

Harmonic Records

Use this window (Figure 2.121) to download harmonic records.

AMETEK recorders produce an average harmonic reading every 10 minutes. Some recorders also store the min., max, average and a snapshot with the angle value. The amplitude and phase of channels assigned to a phase group are recorded up to the 64th harmonic. Content may be limited by the sample rate of the recorder.

Buttons and Fields

Retrieval parameters

Select the start and end times and dates from the log. The default is the complete interval.

The sampling interval can be reduced from every 10 minutes to 20, 30 or 60 minutes

Max. number of harmonics

Select the maximum harmonic number up to the 48^{th} for the TR100, 64^{th} for the TR2000 and 63^{rd} for the TR100+ and PQR.

Record format

Select the data format for a TR2000 & PQR:

- *Average*
- *Max, Min, Average*
- *Magnitude, Angle*
- *Max, Min, Average, Magnitude, Angle*

For a TR100 and TR100+ the format is Average.

Harmonic Record Retrieval Operations

To retrieve harmonics records:

1. Select **Harmonic Records** and the Harmonics Data Available On Connected Recorder dialog appears (Figure 2.121).

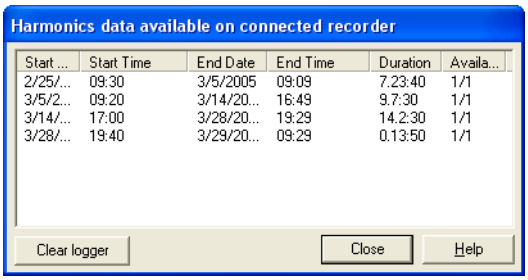

Figure 2.121 Harmonics Data Available On Connected Recorder

Individual harmonic logs are listed with their times and dates.

2. Double-click on a record and the Retrieve harmonic data record appears (Figure 2.122).

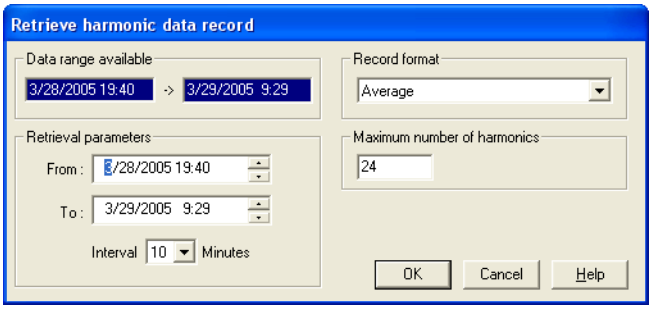

Figure 2.122 Retrieve Harmonic Data Record

3. Use the spinners to set the *From* and *To* dates for the records required.
4. Use the *Interval* spinner to set the interval.
5. Use the spinner to set the record format.

6. Enter the *Maximum number of harmonics*.
7. Click **OK** and a dialog appears.
8. Click **Yes** and the records are downloaded.

Logger Records

Use this window to download the logger data available on connected recorder.

Each logger file contains a continuous sequence of data samples. Certain events can cause the start of a new log file to ensure that the recording in each file is continuous. These include switching the system off, updating the system parameters and changing the system time.

Buttons and Fields

Clear Logger — Deletes all logged data on the connected recorder. Level 2 security is required.

Retrieve Logger Data Record

Use this window to retrieve logger data from a connected recorder. Depending on the recorder type and options a range of continuous quantities are saved in separate logs in the recorder.

Data range available

Indicate the range of time over which logger data is available.

Retrieval Parameters

From — Enter the date and time when the retrieval record starts. Enter the date and time when the retrieved record should end.

Interval — Select the interval required between logged samples, in minutes.

For the TR2000 & PQR there are five different logger files. The standard logger (RMS & frequency), Energy, Imbalance & Flicker logs are all available from this screen. The harmonics log is available from the Recorder – Harmonic Records menu. For the TR-100+ the standard RMS and frequency logger and optional Power Logger are available. For the TR-100, the flicker and standard (RMS and frequency) optional logger files are available.

Logger Record Retrieval Operations

To retrieve logger records:

1. Select **Logger Records** and the Logger Data Available On Connected Recorder dialog appears (Figure 2.123).

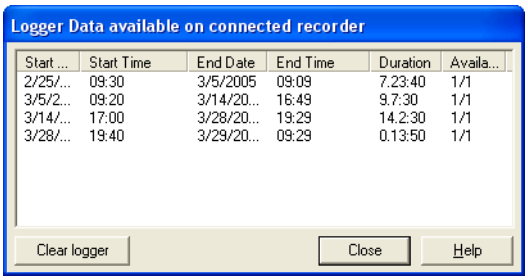

Figure 2.123 Logger Data Available On Connected Recorder

Individual logger files are listed with their times and dates.

2. Double-click on a record and the Retrieve Logger data record appears (Figure 2.124).

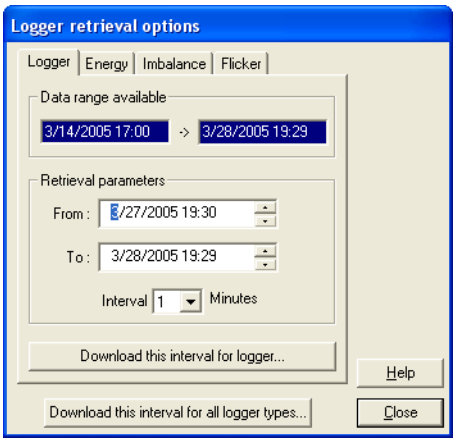

Figure 2.124 Logger Retrieval Options - Logger Tab

NOTE

Each of the four tabs functions in the same manner.

3. Use the spinners to set the *From* and *To* dates for the records required.
4. Use the *Interval* spinner to set the interval.

5. Click either:
   - **Download this interval for logger**.
   - **Download this interval for all logger types**.

   A dialog appears.
6. Click **Yes**.

Disturbance Records (TR2000, TR100+ & PQR)

Use this window (Figure 2.125) to download disturbance records. It lists the headers of all the records that were requested for download in the Record Selection window. All records are displayed by date and time and those records that have not been previously marked as read to the Display Station are marked with a tick in the New column.

Each record header is transferred to the Display Station with its profile (if selected) which contains the signal levels before, during and after the trigger, the maximum and minimum values during the record (Analog profile) as well as the contact transition times (Digital profile). These data may be viewed by double clicking on the record entry.

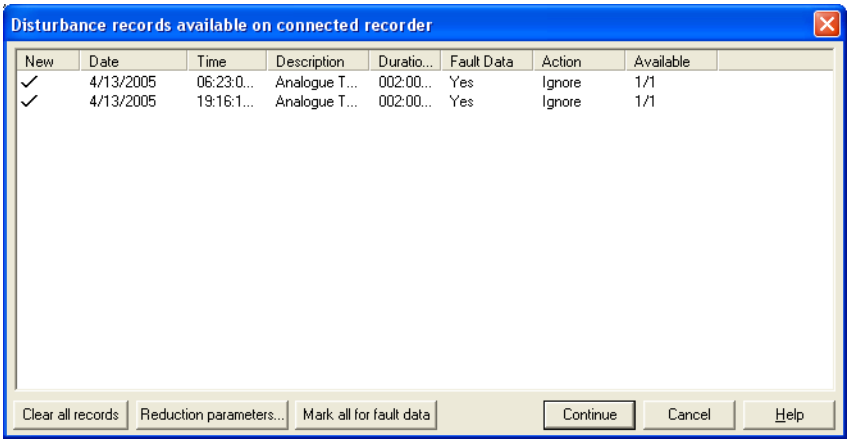

Figure 2.125 Disturbance Records Available

Buttons and Fields

Fault — Shows if the data is available on the recorder or whether it has been overwritten.

Action

Tells Display Station 32 what to do with the records listed. To set the value of this field, see the Right Click and Double Click sections below. There are four possible values, each of which refers to what Display Station 32 does with the record when the Continue button is clicked:

- *Ignore* - Nothing is done with the record (default)
- *Fault data* - The record's fault data is downloaded
- *Profile* - The record's profile is downloaded
- *Reduced* - Reduced data is downloaded for the record (as set up in Record reduction parameters)

Clear All Records

Deletes all the disturbance records on the connected recorder.

Reduction Parameters

Opens up the Record Transfer Options window, which is used to reduce the data being downloaded for the selected record.

Right Click

Right-click over a record in the list a popup menu appears. This menu has several options used to manipulate and view the record. Four of the options can be used to set the Action column, i.e. Ignore, Mark fault data, Mark profile only and Reduced fault data, when selected sets the Action column to Ignore, Fault data, Profile and Reduced (not TR100) respectively.

If the profile flag has been set in the Transient Record Selection window then more options are available, for viewing the profile. These are:

- *Analogs* - Opens the Analog Profile window showing a summary of RMS levels on each channel before, during and after a fault.
- *Digitals* - Opens the Digital Transitions window, showing digital transitions during the fault.

Double Click — Double-clicking on a record with the left mouse button opens the Record window, which shows the record's header information and gives options for viewing and manipulating the record.

Analog Profile — Displays the RMS levels of the cycles immediately before and after the start and end of the trigger condition. The maximum and minimum values throughout the duration of the record are also included.

The fault duration is the time in ms, between the start and end of the trigger condition. For a digital edge or manual trigger this value is zero.

This information is used to give an indication of the type and level of a line fault without having sight of the complete graphical record.

Digital Transitions

Displays the digital transitions that occurred during a disturbance record.

Disturbance Record Retrieval Operations

To download disturbance records:

1. Select **Disturbance Records** and the Record selection dialog appears (Figure 2.126).

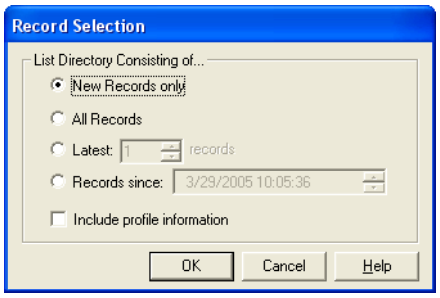

Figure 2.126 Record Selection

2. Click the radio button associated with the record range required. For:
   - **New Records only**- selects only records not previously downloaded
   - **All Records** - selects all records
   - **Latest** - use the spinner to select the number of records
   - **Records since** - use the spinner to select the record start date

3. Click the **Include profile information** check box to download the profile data for the records, if required.
4. Click **OK**.

   The Disturbance records available on connected recorder dialog appears (Figure 2.127).

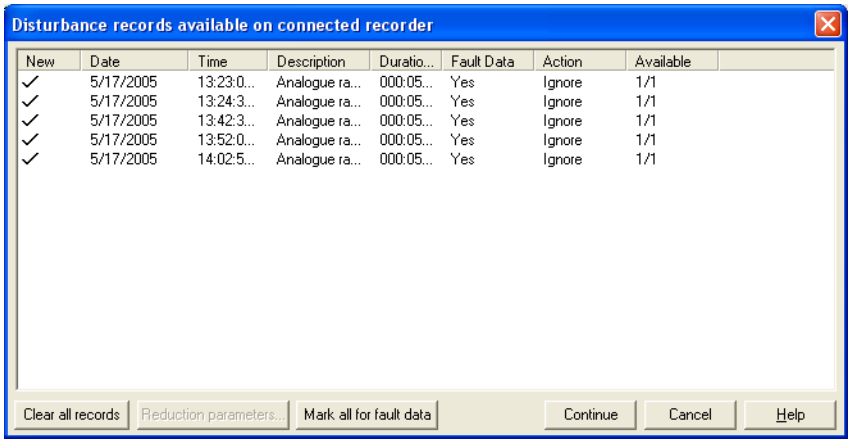

Figure 2.127 Disturbance Records Available

5. Click **Reduction parameters** to reduce the records being downloaded (Figure 2.128).

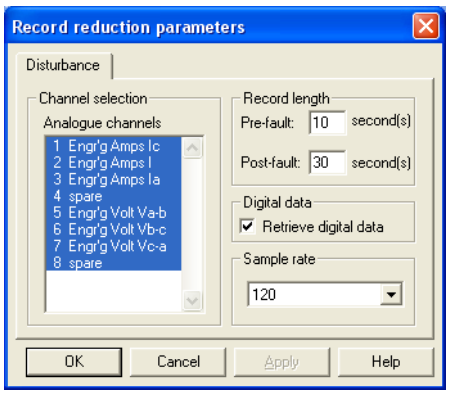

Figure 2.128 Record Reduction Parameters

6. Configure parameters on the dialog as required and click **OK**.

   The Disturbance records available on connected recorder dialog reappears.

7. Click **Mark all records for fault data**, or select required records individually, to download all associated fault data.
8. Click **Continue** and the records are downloaded.

Disturbance Logger (TR2000)

Use this window (Figure 2.129) to download logger disturbance records. The TR2000 has an option to continuously log its input quantities and the two frequency channels. This is recorded at 25Hz for a 50Hz system and 30Hz for a 60Hz system. The log is circular and contains the previous 14 days worth of data. The recovered data contains phasor information so DSA can compute derived values such as power and impedance.

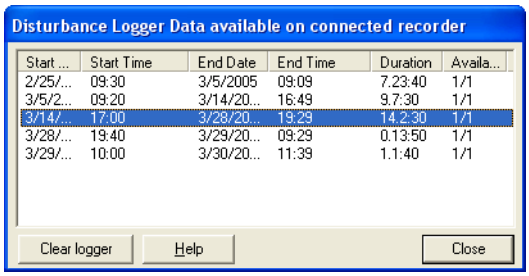

Figure 2.129 Disturbance Logger Records Available

Buttons and Fields

Data range available

Displays the range of time over which logger data is available for the selected record.

Retrieval Parameters

From — Enter the date and time when the retrieval record starts.

To — Enter the date and time when the retrieved record ends. Because of the relatively high sampling rate it is recommended that only short intervals be recovered at a time.

Reduced — Activates whether the recovered file contains reduced data. The parameters for this are defined in the recorder configuration. The Data Available column in the Disturbance directory shows Reduced data for these files.

Retrieve Disturbance Logger Records Operations:

To retrieve logger records:

1. Select **Disturbance Logger Records** and the Disturbance Logger Data Available On Connected Recorder dialog appears (Figure 2.130).

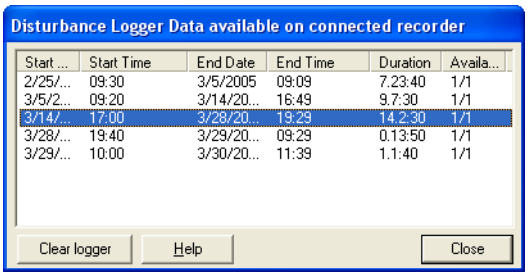

Figure 2.130 Disturbance Logger Data Available On Connected Recorder

Individual logger files are listed with their times and dates.

2. Double-click on a record and the Retrieve disturbance logger data record appears (Figure 2.131).

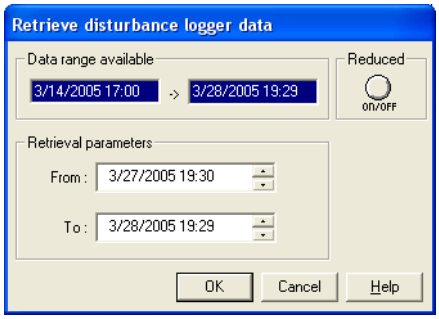

Figure 2.131 Disturbance Logger Retrieval Options

3. Use the spinners to set the *From* and *To* dates for the records required.
4. Click **on/off** to download reduced data.
5. Click **OK** and a dialog appears.
6. Click **Yes**.

View Menu

This menu is used to view the event and communications logs stored by Display Station.

Event Log

The Event Log window (Figure 2.132) shows a list of event and alarm messages from recorders.

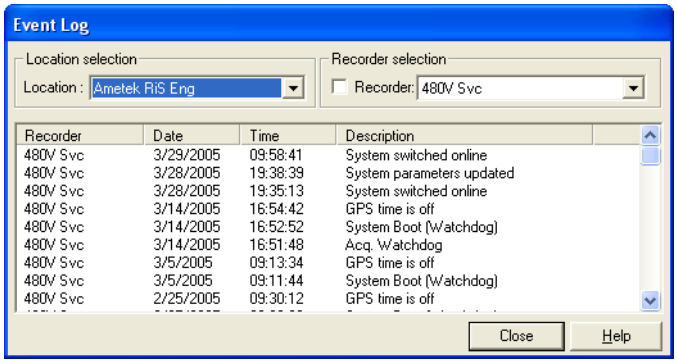

Figure 2.132 Event Log

Buttons and Fields

Location Selection — Select the events of a particular location. Only one location can be viewed at a time.

Recorder Selection — Select a recorder within a location. To make this filter active, click on the check box supplied.

Communications Log

This window (Figure 2.133) lists the communications messages where Display Station has tried to connect to recorders and failed. This is useful for auto-poll where the process is normally unattended. There are three separate pages controlled by a tab at the top. The Communications Log contains all activity and the Successful auto comms and Failed auto comms are separated into the other two pages.

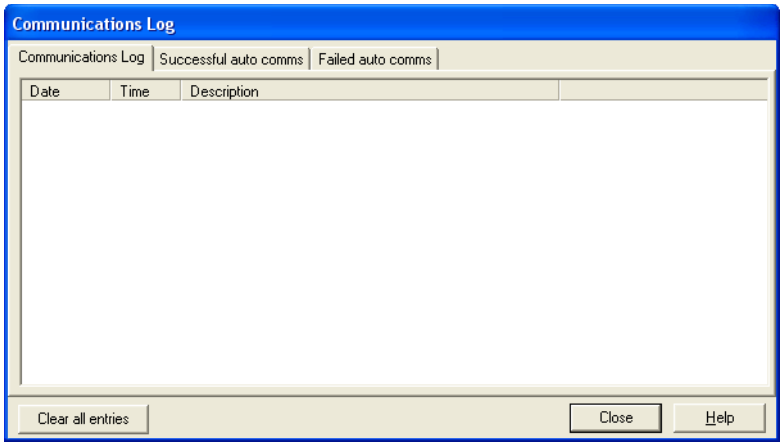

Figure 2.133 Communications Log

Button and Fields

Clear All Entries Clears all the entries of the communications log.

Database Menu

The options of this menu maintain the Display Station database:

- Update File Links
- Repair
- Compact
- Create Archive
- Import Archive

Update File Links

The DS database stores the header information for each record in the Display Station 32 data directory. The actual record data are stored in the data directory as separate files. Each record in the database stores the name of its data file. It is possible for these file references to become damaged if, for example, records are copied to and from the data directory without using the Directory maintenance facility.

To update file links:

- Select *Database > Update File Links.*

  This forces Display Station 32 to traverse through all of its database records and ensure that they are pointing to the correct data files.

Repair

Display Station 32 database can become corrupted, for example if the computer is turned off while it is being read or written to. Selecting Repair attempts to repair any damage that may occur.

NOTE

Repairing the database requires exclusive access, if Display Station 32 is being run as a multi-user system, then it is essential that no other copies of Display Station 32 are running at the same time.

To repair files:

- Select *Database > Repair.*

Compact

The database system used for Display Station 32 grows in size every time records are added but does not decrease again if these are deleted. This function reclaims unused space within the database.

NOTE

Compacting the database requires exclusive access, if Display Station 32 is being run as a multi-user system, then it is essential that no other copies of Display Station 32 are running at the same time.

To repair files:

- Select *Database > Compact.*

Create Archive

The DS32 database keeps a copy of the header information and expert system results for each record it downloads or imports. Over time, the size of the database can become extremely large (greater than 800 Mbytes). When this occurs, use this window to archive old records out of the database.

Buttons and Fields

Dates	Use the Start date and End date fields to enter the dates when archiving starts and ends.
Archive path	Enter a pathname and file name for the archived material. Alternatively, use the browse button to select a path and filename.
Create	Creates the archive. All archived records are deleted from the Display Station 32 database.

Create Archive Operations

To create an archive:

1. Select *Database > Create Archive*.

The Create Archive dialog appears (Figure 2.134).

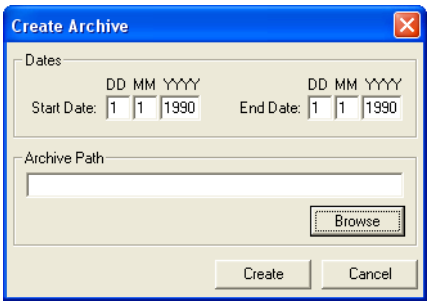

Figure 2.134 Create Archive

2. Click **Browse**.

The Select or enter a name for the Archive Database dialog appears (Figure 2.135).

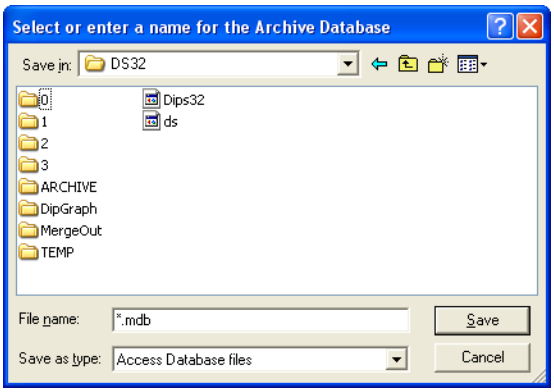

Figure 2.135 Select or enter a name for the Archive Database

3. Navigate to or enter a name for a new database and click **Save**.

The Create Archive dialog reappears (Figure 2.134).

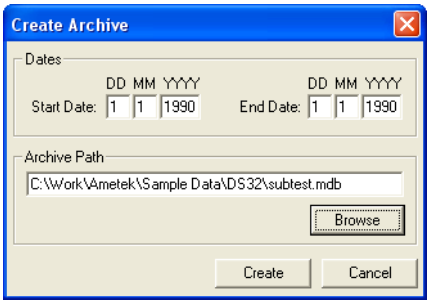

Figure 2.136 Create Archive II

4. Enter a *Start Date* and an *End Date* and click **Create**.

Import Archive

Use this window to re-import an archive that was created using Create Archive.

Buttons and Fields

Archive path	Enter the path and name of the archive file to import. Alternatively, use the browse button to find the required file.
Import	Re-integrates the selected archive into the Display Station 32 database.

Import Archive Operations

To import an archive:

1. Select *Database > Import Archive*.

The Import Archive dialog appears (Figure 2.137).

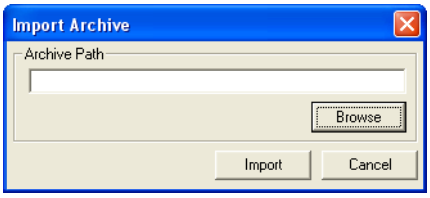

Figure 2.137 Import Archive

2. Click **Browse**.

The Select an Archive to Import dialog appears (Figure 2.138).

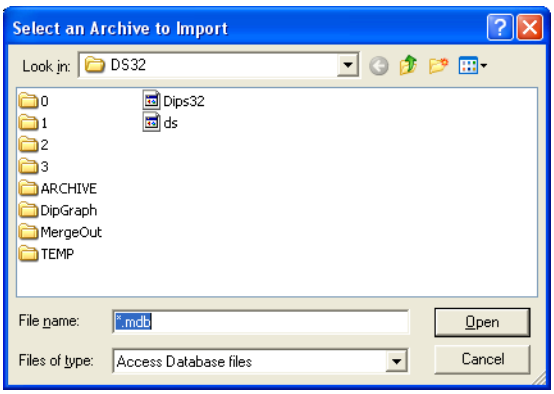

Figure 2.138 Select an Archive to Import

3. Navigate to the archive and click **Open**.
   The Import Archive dialog reappears (Figure 2.139).

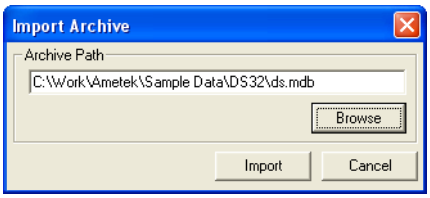

Figure 2.139 Import Archive II

4. Click **Import**.

3. Display Station Analysis 32 Menus and Operations

This chapter describes functions available for manipulating separate records and windows.

The chapter consists of the following sections:

- ″DS32 Analysis Window General Operations″, a discussion of the main window's functions and capabilities.
- ″Main Toolbar/PAT Toolbar″ on page 3-17, a discussion of the items accessed from the toolbar. General discussions and specific procedures appear.
- ″Main Menu Bar″ on page 3-19, a discussion of the items accessed from the toolbar. General discussions and specific procedures appear.

DS32 Analysis Window General Operations

This sections consists of:

- ″Graph Window Operations″
- ″Warning Messages″ on page 3-14
- ″Phase Group Classification″ on page 3-16

There are three ways to open a DSA32 record:

- Double-click a DS32 transient, disturbance or logger record and then click **Analyze fault data** on the record dialog.
- Select *File > Open Record* and the DS main window appears. Double-click a DS32 transient, disturbance or logger record and then click **Analyze fault data** on the record dialog.
- Select *File > Open file,* use the Open dialog to navigate to the record and click **Open**. This works for COMTRADE files as well.

Figure 3.1 shows the Display Station Analysis main window.

You can:

- Open multiple records separately
- Create new graphs
- Modify graph presentation and save as your new default presentation

The *active graph* is the graph shown in the window and its record is the *active record*.

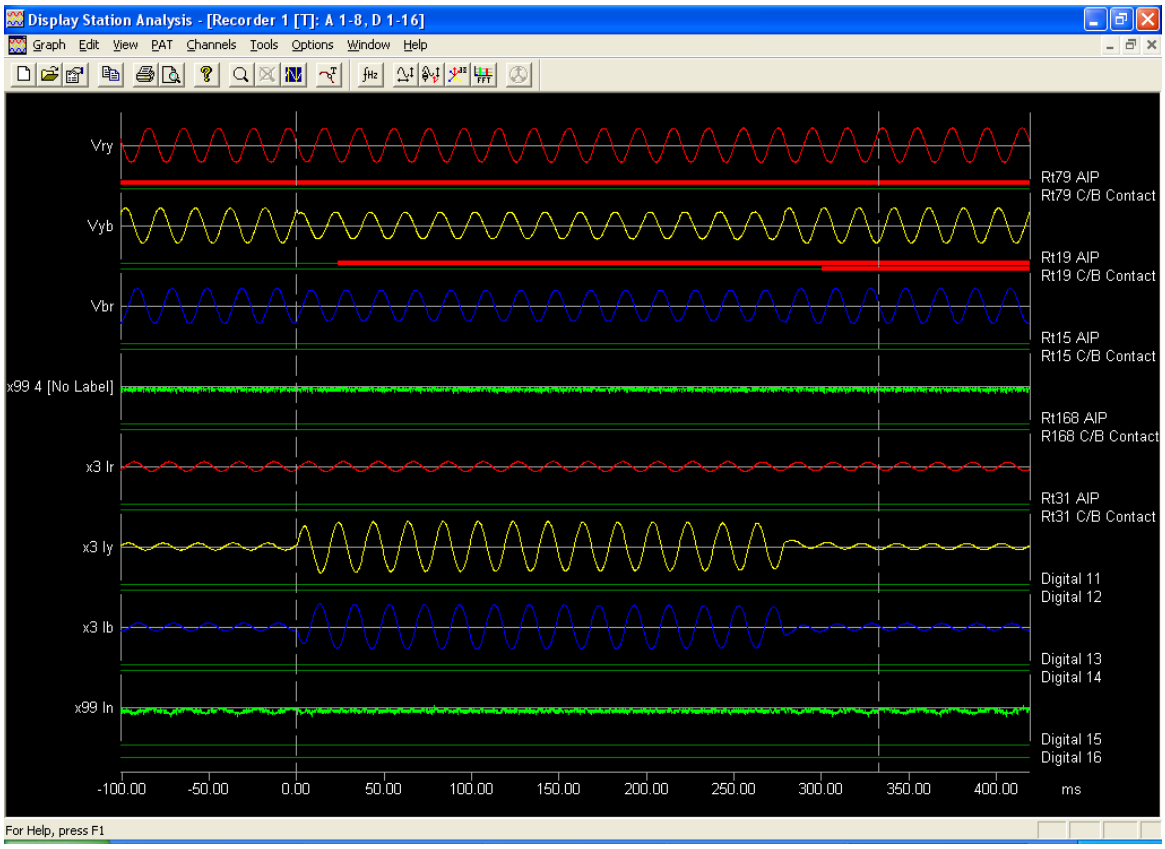

Figure 3.1 Display Analysis Main Window

The DSA main window is made up from three parts:

- A menu and toolbar at the top,
- A status bar at the bottom,
- and the waveform displays in between that is divided into a number of bands. Each band contains one or a number of waveforms.

A range of display manipulation functions are available to extract the maximum amount of useful information from the recorded data. These include scaling, zooming, panning, dual cursor measurements, Power Analysis Toolkit (PAT), computing new channels and importing channels.

Other analysis functions can be added to the Tools menu. These include:

- Distance to Fault (DTF)
- Expert system

Graph Window Operations

DSA32 displays records in one or more *graph* windows contained within its main window. Each graph window can display any combination of channels from a single record together with any channels imported from other, open records.

Graph windows are arranged in horizontal bands each of which contains one or more channels. Each band is assigned a label. This defaults to the name of the first channel added to the band.

For:

- Analog bands the label appears to the left of the signal. The vertical zoom (gain) applied to analog bands appears before the channel's label (i.e. *x10* indicates a times 10 multiplication).
- Digital bands the label appears to the right.

Underneath the bands a horizontal time axis is drawn. Time values appear at equidistant points along the axis at an interval suitable for the period of time in use.

When the graph has been zoomed a horizontal scrollbar appears below the time axis for panning through the record. The axis label depends on the record type.

Transient records display times in seconds, milliseconds or microseconds depending on the sampling rate during record creation. To keep the display manageable it sometimes appears in tens or hundreds of the base unit. This is indicated in the unit description given to the right of the axis that reads something like *x10 ms* - this means that each tick on the axis gives a value in tens of milliseconds.

Disturbance records display their times on the axis in a *minute:second* format with the seconds given to two decimal places.

Logger records display their times in a *day-hour:min* format.

Status Bar

The status bar appears at the bottom of the main DSA32 window and displays general status and help information. It is toggled on/off using *View > Status Bar.* Hiding the status bar frees up screen space for use in displaying graphs, which may be significant when DSA32 is run at lower resolutions.

The main part of the status bar displays text messages such as a brief summary of menu operations as the cursor passes over them. Brief help messages for both the main toolbar and the PAT toolbar also appear here. Some DSA32 options display a progress control here to provide feedback during time consuming operations.

The rightmost part of the status bar contains three recessed areas that indicate the status of the <Cap Lock>, <Num Lock> and <Scroll Lock> keyboard key, respectively.

Bands

The display area of a graph window is divided among the channels (Figure 3.2) on display. This division occurs by allocating the screen area as an appropriate number of non-overlapping, horizontal *bands* within which signals are drawn. There are two band types:

- Analog bands
- Digital bands

Their height is set to fill the available space with all analog bands being of equal height and all digital bands being of equal height.

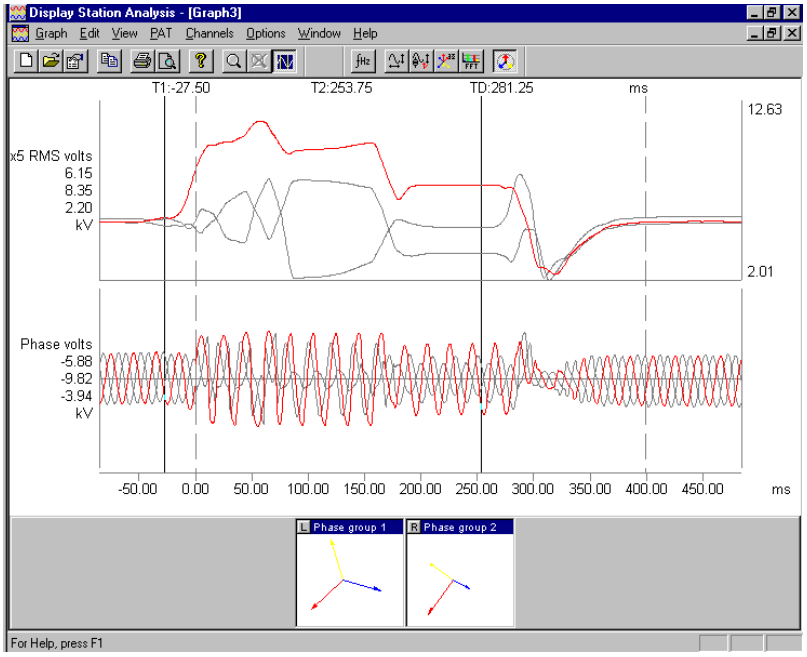

Figure 3.2 Main Window Bands

Each band is used to display one or more channels. DSA32 does not require that overlaid channels share the same unit, but if they were recorded with differing full scale deflection values, then a warning appears that visual comparisons are inaccurate. In other words, a point representing 100V in one of the channels may be drawn lower than a point representing 50V in the other channel because the latter represents a different range of values.

No combination of digital, monopolar and bipolar analog channels is permitted within the same band.

Vertical scaling (gain) can be applied separately to each analog band in the window. This scaling is applied to every channel in the band and may result in the signal moving off the visible range.

Phasor Display

Figure 3.3 shows a blowup of the Phasor Display.

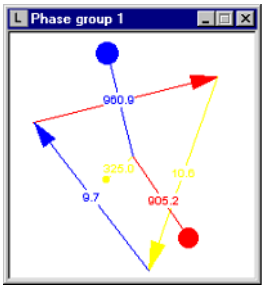

Figure 3.3 Phasor Display

By default the displays appear in a bar at the bottom of the graph window where their display size is fixed with respect to the graph size. For more flexibility open individual displays in their own free-standing windows.

The free-standing display can be resized but always retains a square aspect ratio. To return it to the graph window simply close the window in the normal way. Only the free-standing phasor displays of the active graph are visible at any given time.

The actual points at which the measurements are made are assigned to either the left or right cursor. As the cursors on a transient record are moved the phasors rotate. By convention, moving the cursor to the right (forward in time) causes the display to rotate counter-clockwise. The phasor display does not rotate for a disturbance record.

This dependence on the cursors means that the phasor display is only available when the cursors are active. If the cursors are disabled the phasor display will be turned off.

If no displays have been configured DSA32 sets up one display on the record's first phase group and attaches it to the left hand cursor and another display on the second phase group attached to the right hand cursor. Both displays show the fundamental vectors.

DSA32 allows the definition of multiple displays. A display is a square area in the bar below the signal display in which phasors are drawn. At the top of the display there is a title and either an *L* or *R* icon indicating that the display is reporting on the Left or Right cursor position.

Each display can show the details of one or more phase groups. If multiple phase groups are defined for a display they are overlapped. Such phase groups are not necessarily scaled identically so visual comparisons of magnitude are inaccurate.

For each phase group assigned to a display any combination of the following can be drawn:

- Fundamental phasors
- Positive phase sequence components
- Negative phase sequence components
- Zero phase sequence components

Phasor Display Operations

To open free standing windows either:

- Right-click on the display and select *Free-standing* from the right-click menu or
- Use the "Phasor Display" on page 3-6.

To enable the phasors:

1. Switch on the cursors.
2. Click  or select *Options > Show Phasors* in the **Options** menu.

To set the reference phasor in Band Settings:

1. Select it as the active channel in the band and the Active sub-channel list is filled with entries for Phase A, Phase B and Phase C.
2. Select the one for which cursor reporting is required. If the reference phasor is specified here, the cursor always reports an angle of zero.

Band Settings

Use this dialog (Figure 3.4) to configure band appearance and select the active channel.

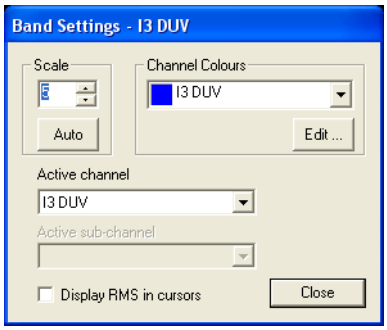

Figure 3.4 Band Settings

Buttons and Fields

Scale

Adjusts the scaling factor. Certain channels can have small signals that are not easily visible. These are automatically magnified to reveal more detail when DSA32 is started, as follows:

- TR100 records - magnification is limited to 99 times for transient records and 1000 times for logger records.
- PQR channel - magnification is limited to 500 times.
- TR100+ and TR2000 - all channels can be magnified x1000.

The magnification scale factor appears to the left of the channel name or as a number on the graph. For x1 no value appears by the channel name. Limit the maximum scale factor using the Preferences dialog ("Preferences" on page 3-43).

A waveform magnified so that it expands outside its display area is clipped so as not to interfere with other channels.

Auto

Assigns the largest scale value that keeps the visible portion of the signal entirely within the band's vertical range. When used with a band displaying monopolar channels this also selects an optimal range of values to display.

Auto operates solely on the visible portion of the channels in the band. If the window is zoomed to show only a small section of the record autoscaling only looks at that small section. Subsequent panning through the record may well reveal that parts of the signal are too large or too small for the band. Reapply the autoscale operation to bring them into view. To ensure that all parts of the signal are always visible, unzoom and then autoscale.

Autoscaling is also on the right-click menu.

Channel Colors

Lists the names of all the channels in the band in a drop down. and its associated color used to draw the signal. Select these in the Colors dialog.

Active channel — Select the active channel from this drop down. When more than one channel is present in the band, the cursors only report values for the active channel. It can also be set in the Graph Setup dialog ("New Graph/Setup" on page 3-28) and in the band right-click menu.

Active sub-channel — Select the active sub-channel from he drop down. Certain channels contain more than one signal. Examples are logger channels that contain maximum, average and minimum signals. The phase angles computed channel contains signals for each phase in the group on which it was based. When such channels are active in a band the cursors report only on one of these sub-channels.

Band Settings Operations

To configure settings:

1. Select *Setup* from a right-click menu and the dialog appears (Figure 3.4).
2. Use the spinners to set the *Scale* or click **Auto** for the largest available scale, if required.
3. Select the *Active channel* from the drop down.
4. Select the *Active sub-channel* from the drop down, if required.
5. Select a color from the *Channel Colours* drop down, if required.

NOTE

The Edit button opens a Windows dialog for configuring special colors. See Windows documentation.

6. Click **Display RMS in cursors** to set it as the display magnitude.
7. Click **Close**.

Power factor

A band containing the:

- Power factor from a TR100+ power logger is bipolar, but is based around a center line of *1*.
- Lagging power factor is drawn above the line and cursor measurements are appended with *L*.
- Leading power factor is drawn below the line and cursor measurements are appended with *C*.

Transient events

Logger records from a PQR fitted with the High Speed Transient Capture option may contain information about transient events that occurred within the duration of the record. These are indicated by a triangular marker against the affected channel (Figure 3.5).

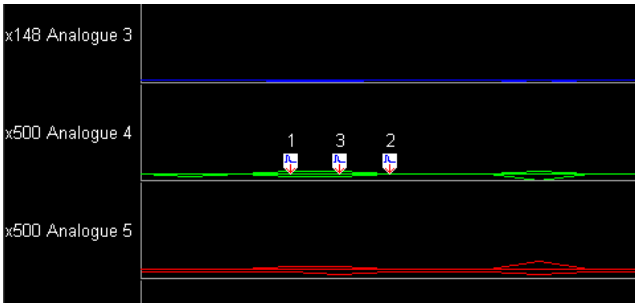

Figure 3.5 PQR Graph with High Speed Transient Capture Markers

- Click on the number above the marker and information about the event or events that occurred during the indicated sample interval appears (Figure 3.6).

The time and date of each event is listed along with the peak voltage, the time for the pulse to decay to 50% of its peak value and the phase angle of the peak relative to the positive zero crossing of the affected channel.

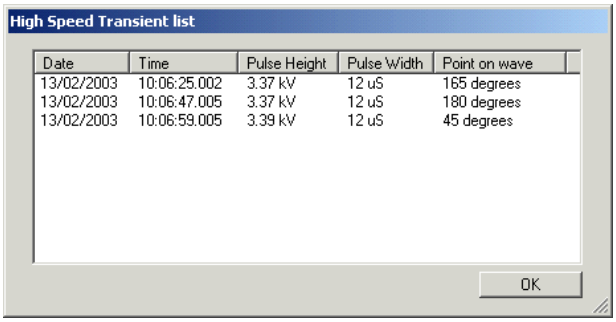

Figure 3.6 High Speed Transient Capture Information

Display Manipulation

There are three ways to manipulate the waveforms:

- Zooming - Extends a selected portion of the record to the full width of the window.
- Panning - Moves a zoomed display through the record, forwards or backwards.
- Scaling - Modifies a band's channels vertical gain.

Panning

Once a display is expanded a horizontal scrollbar appears at the bottom of the window. Use this to pan over the data:

- Click on the arrows at the data at either end scrolls smoothly. Holding down <Shift> key while scrolling minimizes the scroll speed.
- Click in the area between the arrow and the moving square causes the graph to jump.
- Click and drag the scroll bar *thumb* pans the display forwards or backwards.

If the screen flashes as it is panned or is slow to update see *Graph Double Buffering* in "Preferences" on page 3-43. Alternatively, use the mouse wheel to pan the record ("Mouse Wheel Support" on page 3-12).

Docking Windows

In DSA32 both the main toolbar and the PAT toolbar are used in two ways:

- Free-floating windows or,
- Docked to the inside of the main DSA32 window.

By default DSA32's toolbars are docked to the top of the main window. In this condition they are part of the window's frame and the contents of the main window are resized so that it cannot overlap the docking area.

If a window is undocked it appears as a window with its own title bar by which it can be dragged. An undocked window overlaps the main DSA32 window and graph windows, PAT dialogs etc. ware drawn under it.

Toolbar Undock/Dock Operations

Undock a docked window

To undock a window:

1. Click between the toolbar buttons and drag it out into the DSA32 window.

2. Release the mouse button and the undocked toolbar appears (Figure 3.7).

Figure 3.7 Undocked Toolbar

Docking a window

To dock a window:

1. Click on the title bar of the toolbar and drag it to the inside edge of the DSA32 window. Dock it to any side - top, bottom, left or right.
2. Release the mouse and the docked toolbar appears (Figure 3.1 on page 3-2).

Mouse Wheel Support

A number of display functions can be duplicated using the mouse control wheel

Mouse Wheel Operations

Pan a record

To pan a record roll the wheel:

- Forward to pan to the left
- Backward to pan to the right

<Shift>+wheel reduces the scroll speed to a minimum.

Zoom a record

To zoom a record:

1. Press *<Ctrl>* and use the wheel.
2. Roll the wheel:
   - Forward to increase the zoom
   - Back to reduce the zoom

Adjust the gain

To adjust gain:

1. Place the mouse pointer over a channel label (the hand cursor appears) the wheel scales that channel or band (see "Band Settings" on page 3-7).
2. Roll it:
   - Forward to increase the gain
   - Back reduces it.

Overlapping Records

Set the Preferences Scan for overlapping records on load option and a search of the Display Station database occurs as each record is loaded. If other records are found in the database that overlap this one, they are marked on the horizontal time axis (Figure 3.8).

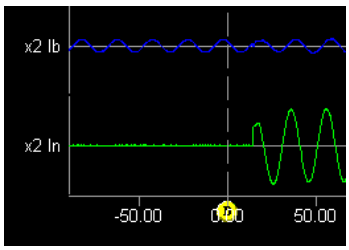

Figure 3.8 Overlapping Records

This is useful for showing where a transient record exists for a disturbance record or logger record. It also indicates if a disturbance record is present for a logger display. This provides an easy way to view the same event at different levels of detail.

Records have the following indicators:

- A transient record has a red circle with a *T.*
- A disturbance record has a yellow circle with a *D.*
- A logger record has a blue circle with an *L*.

Overlapping Record Operations

To open overlapping records:

1. Double-click on the symbol and the record details appear

   If there is more than one record at that time, multiple details appear.
2. Click on the detail to open its record.

Right Click Menu

Figure 3.9 shows the DSA right-click menu. Menu items are explained below.

To access this menu:

- Move the mouse over the band label and  appears - right-click.

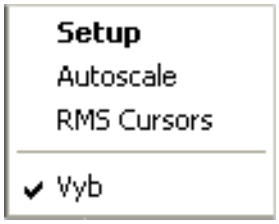

Figure 3.9 DSA Right-Click Menu

Setup	Opens the Band Settings dialog ("Bands" on page 3-4).
Autoscale	This autoscales the channels in the band.
RMS Cursors	Toggles the band cursor display between instantaneous and RMS quantities for transient records.

Labels for all the band channels appear below. The active channel has a checkmark.

Warning Messages

During DSA32 operation a number of warning messages can appear, including:

Alternate Phase Group Classification

When working with non-TR2000, TR100+ and PQR records it is necessary to provide phase group classifications. These classifications are stored in the Display Station database.

Channel Import Synchronization Issues

The Import Channels facility is used with TR2000 records. Such records are produced with synchronous sampling so that any two machines will sample the live signals at the same instant. This allows DSA32 to synchronize the records exactly from their time details.

With non-TR2000 records, there may not be synchronous sampling so importing encounters a fixed error of up to half the sample period of the record into which the channel is imported.

Line Group Information Unavailable

A number of DSA32 dialogs allow the selection of a line group. Line groups are not defined in non-TR2000, TR100+ or PQR records and so when working with these records the line group selection is disabled.

Display Station not running

This message appears when selecting *Graph > Open record.* This facility hands control over to Display Station for record selection. If Display Station is not running the operation cannot complete. To remedy this situation, restart Display Station.

Phase group information unavailable

Records generated by older recorders, such as the TR100, DL8000 or TR1600 and COMTRADE records, do not contain some of the phase group information held by the TR2000, TR100+ or PQR. Specifically:

- VT type, i.e. phase-to-phase or phase-to-neutral
- Group type, i.e. voltage phase group or current phase group

These details are required for some of DSA32's computed channels. See "Older Records" on page 3-20.

A number of features are only available for Transient and Disturbance records. These operations are unavailable for Logger records.

Phase Group Classification

When non-standard records are opened in DSA32 it is necessary to provide a classification of each of the record's phase groups. This is required as certain details required to complete some operations are provided in some records but missing from previous types. Specifically, for each phase group the following details are needed:

- VT type, i.e. phase-to-phase or phase-to-neutral
- Group type, i.e. voltage phase group or current phase group

This classification occurs either as soon as the record is loaded or when the first operation requiring the missing information is requested. The timing is set in the Preferences dialog ("Preferences" on page 3-43).

The Classify Phase Groups dialog lists three choices:

- *Classify this record* - the classification provided is recorded against this record for all future uses.
- *Classify this machine* - the classification provided is recorded against *the machine that produced this record* and every record retrieved from that machine uses this same classification.
- *Use defaults* - no classification is provided and DSA32 continues with its best guesses as to the phase group details. This temporary classification is not recorded and he Classify Phase Groups dialog reappears when the record is reopened.

If a record or machine is incorrectly classified use "Reclassify" on page 3-36 to correct it.

See "Older Records" on page 3-20 for a full procedure.

Main Toolbar/PAT Toolbar

A number of commonly used operations in DSA32 are accessed through the buttons on the main and PAT toolbars.

The main toolbar accesses the following functions listed in Table 3.1.

Table 3.1 DSA Main Toolbar Icons

Icon	Function
	New graph ("New Graph/Setup" on page 3-28)
	Open record ("Open Record" on page 3-19)
	Graph setup ("New Graph/Setup" on page 3-28)
	Copy the active graph to clipboard ("Copy" on page 3-39)
	Print the active graph ("Print/Print Preview/Print Setup" on page 3-37)
	Print preview for the active graph ("Print/Print Preview/Print Setup" on page 3-37)
	About DSA32 ("About DSA32" on page 3-115)
	Zoom the active graph ("Time Axis" on page 3-103)

Table 3.1 DSA Main Toolbar Icons (Continued)

Icon	Function
	Unzoom the active graph (”Time Axis” on page 3-103)
	Toggle cursors in the active graph (”Cursors” on page 3-104)
	Add an annotation to the current graph (”Add Annotation” on page 3-105)

The PAT toolbar accesses the following functions listed in Table 3.2. For all the options apart from System Frequency, the buttons remain in the inactive state as long as their associated dialog is visible. Clicking them again closes that dialog. The Phasors button remains inactive as long as the phasor display is active.

Table 3.2 PAT Toolbar Icons

Icon	Function
	Open the System Frequency dialog (”Fundamental Frequency” on page 3-52)
	Open the Single Channel Calculations dialog (”Single Channel” on page 3-53)
	Open the Power Calculations dialog (”Power” on page 3-55)
	Open the Sequence Components dialog (”Sequence Components” on page 3-60)
	Open the Harmonic Analysis dialog (”Harmonics” on page 3-63)
	Open the Phasors dialog (”Phasor Display Setup” on page 3-30)

Main Menu Bar

The Display Station main menu bar consists of:

- ″Graph Menu″
- ″Edit Menu″ on page 3-39
- ″View Menu″ on page 3-40
- ″Power Analysis Toolkit (PAT) Menu″ on page 3-51
- ″Channels Menu″ on page 3-66
- ″Tools Menu″ on page 3-101

Graph Menu

DSA uses a selected or default layout to display the recorded waveforms. This layout is created or edited using ″New Graph/Setup″ on page 3-28. The layout can be saved for use with the current and other records.

Menus items include:

- ″Open Record″
- ″Open File″ on page 3-21
- ″Close″ on page 3-22
- ″CSV Export″ on page 3-22
- ″COMTRADE Export″ on page 3-26
- ″New Graph/Setup″ on page 3-28
- ″Setup Colors″ on page 3-34
- ″Reclassify″ on page 3-36
- ″Print/Print Preview/Print Setup″ on page 3-37
- ″Exit″ on page 3-39

Open Record

Up to 30 records can be opened at the same time in DSA.

Open Record Operations

To open a record:

1. Open a new record by either:

- Selecting **Open record** in the Graph menu
- Clicking  on the main toolbar.

This opens the Display Station scrolling list of records.

NOTE

Older records may need to be reclassified. See "Older Records".

2. Double-click on the record entry and the associated record dialog appears. The nature of this dialog depends on the record type.

Older Records

For older records whose phase groups have not yet been classified the Classify Phase Groups dialog appears (Figure 3.10).

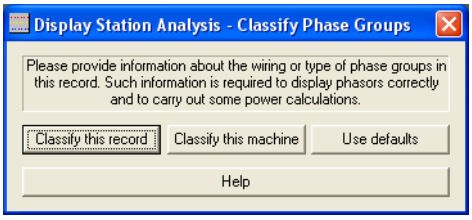

Figure 3.10 Classify Phase Groups I

1. Click the appropriate button:
   - **Classify this record**
   - **Classify this machine**
   - **Use defaults**

   The Display Station Analysis Classify - Phase Group dialog appears (Figure 3.11) for the first two bullets.

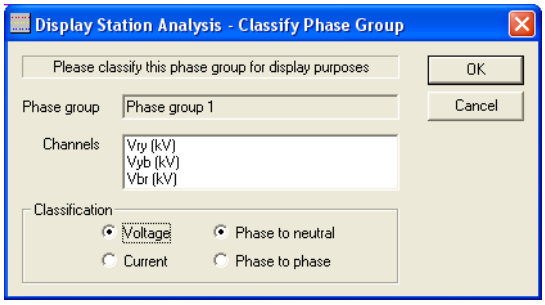

Figure 3.11 Classify Phase Groups II

2. Select a channel from *Channels* and a *Classification* for a Phase group and click **OK**.

   This repeats until all Phase groups are configured. The Display Station Analysis main window appears ready for use.

NOTE

When Current is selected as the Type of the group, the wiring selection is disabled and a default of phase-to-neutral is set.

Click Cancel during this process and any classifications already confirmed are saved against the record or the machine as appropriate. DSA32 continues this session using its best guesses for the unclassified phase groups and, if the record is re-opened later, the Classify Phase Groups dialog reappears but only previously skipped phase groups need be classified.

If the layout of the record has been previously saved the Restore Layout dialog appears (Figure 3.12).

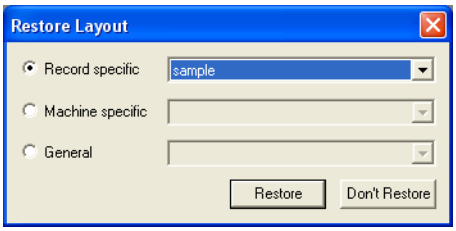

Figure 3.12 Restore Layout

- Click the required radio button and use the spinner to select the record and click **Restore**.

The behavior of Classify Phase Groups and Restore Layout is controlled by settings selected in "Preferences" on page 3-43.

Open File

Use this option as a quick way of viewing records that are not in the normal list (e.g. archived records on a floppy disk).

NOTE

DSA32 supports IEEE C37.111-1999 standard records with no channel amplitude offsets and a single recording frequency.

Open File Operations

To open a file:

1. Select *Graph > Open file.*

   The Open dialog appears.

2. Navigate to a directory and select a file a transient, disturbance or logger record. Additionally, a COMTRADE format record can be specified for import.

Close

This closes all active graphs for a record.

To perform this operation:

- Select *Graph* > *Close* or click the close box *X* at the top right of the window.

CSV Export

Use this window (Figure 3.13) to export data from the active record. Some, or all, of the channel data can be exported to a file. The format used for this file is *Comma Separated Variable* or *CSV*. This format can be read by many third party applications, such as spreadsheets etc.

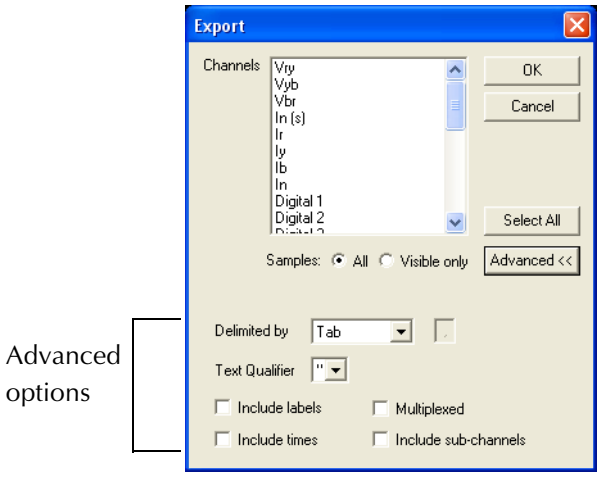

Figure 3.13 CSV Export

Buttons and Fields

Channels	Lists all of the active record channels. Select one or more for inclusion in the export.
Select All	Selects all of the record's channels.
Samples	Click one of the radio buttons:
	All - exports the sample data for the full duration of the record.

	Visible only - export operates in conjunction with the Zoom setting to export only that portion of the record currently visible in the active graph. If a two minute period of a thirty minute log is zoomed, this produces a CSV file containing only the data for that two minute period.
OK	Performs the export operation. The operation progress appears on the status bar. For all but the largest records, this should take no more than a few seconds.
Advanced Export	Toggles the Advanced section into view. There is some variation in the format of the CSV files used by other applications. The default settings produce a file that can be loaded immediately by the leading desktop applications. However, other packages may require a slightly different CSV format which is the purpose of Advanced options.
Delimited by	Configures the separator character used in the CSV output. By default a comma is used to separate values in each line of output. This can be changed to a tab or semicolon or, using the Other option, any arbitrary character is entered in the text field alongside the drop down list.
Text Qualifier	Changes the characters that enclose text data. Text data, such as channel labels and units, are enclosed in standard quotation marks by default - e.g. *"Channel 1"*. A pair of apostrophes are available, or no distinguishing character at all.
Include labels	Enable this check box and extra text items are added at the start of the CSV giving the location, machine name, trigger time and sample rate of the record. Each of these items consists of two pieces of text: • A description of the data e.g. *"Location"*, and • the data itself e.g. "Moira". It also includes the channel name and unit at the head of each channel's data.

Multiplexed

Toggles the data format from row-based to column-based.

With the box unchecked the output for an export of three channels, A, B and C might look like this (where A-1 represents sample 1 in channel A and so on):

A-1, A-2, A-3, A-4, ...

B-1, B-2, B-3, B-4, ...

C-1, C-2, C-3, C-4, ...

With the *Multiplexed* box checked would appear like this:

A-1, B-1, C-1

A-2, B-2, C-2

A-3, B-3, C-3

...,...,...

NOTE

Non-multiplexed files may have extremely long line lengths, with many thousands of sample items on each line. This could cause problems if the file were loaded into a simple text editor or other program.

This setting affects the channel name and unit information provided when the Include labels option is checked. When the Multiplexed option is:

- Unchecked the items are added at the start of each channel's row like this:

"Channel A", "kV", A-1, A-2, A-3, A-4, ...

"Channel B", "kV", B-1, B-2, B-3, B-4, ...

"Channel C", "kV", C-1, C-2, C-3, C-4, ...

- Checked, the items are added at the top of each channel's column like this:

"Channel A", "Channel B", "Channel C"

"kV", "kV", "kV"

A-1, B-1, C-1

A-2, B-2, C-2

A-3, B-3, C-3

...,...,...

Include sub-channels

Activate this check box to include sub-channel data in the export.

Include times — Activate this check box to include times in the export.

CSV Export Operations

To export into CSV format:

1. Select *CSV Export*.

The Export dialog appears (Figure 3.14).

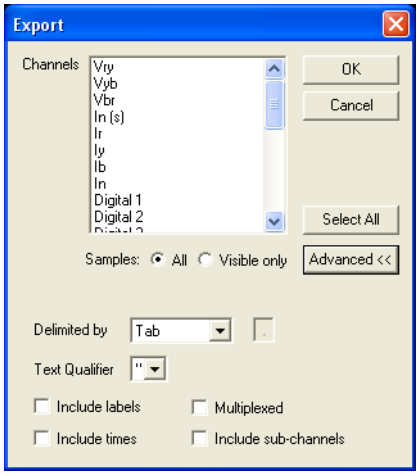

Figure 3.14 CSV Export

NOTE

The graphic in Figure 3.14 has Advanced features showing. Click Advanced to display these items.

2. Select the required *Channel*(s) and configure other desired *Advanced* items.

3. Click **OK** and the Save As dialog appears (Figure 3.15).

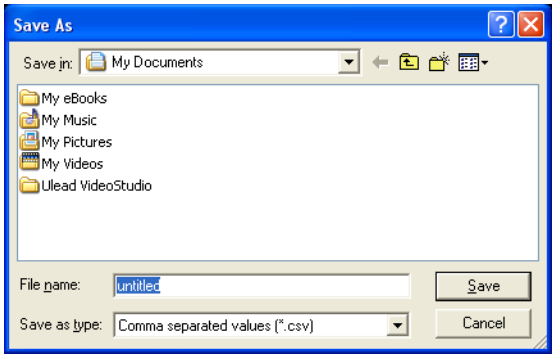

Figure 3.15 CSV Save As

4. Navigate to the required directory, enter a name and click **Save**.

COMTRADE Export

Use this window (Figure 3.16) to export COMTRADE data.

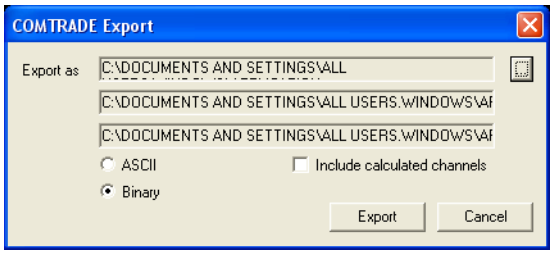

Figure 3.16 COMTRADE Export

Buttons and Fields

Export as	Display the names for the three files that are created by the export. The browse button to the right opens a standard Save as dialog to use a different filename or folder. It is the configuration (*.cfg) filename that is specified here but on return from the dialog, all three filenames are updated appropriately.
ASCII/Binary	Click a radio button to select the file format: *ASCII* - the larger format. *Binary* - the more compact format. This only affects the *.dat file.

Include calculated channels

Check this and any computed channels created in the active record are included in the COMTRADE file.

Export — Performs the actual export according to the specified criteria. If one or more of the output files already exists, a confirmation dialog appears before they are overwritten.

Comtrade Export Operations

To export a Comtrade file:

1. Select *COMTRADE Export*.

   The COMTRADE Export dialog appears (Figure 3.17).

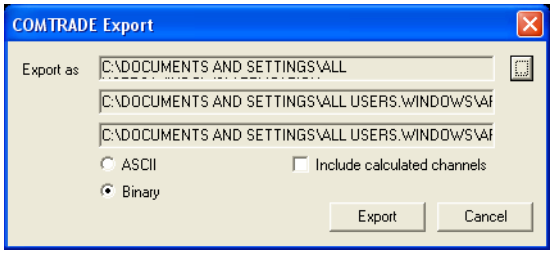

Figure 3.17 COMTRADE Export

2. Click the browse button  .

   The Save As dialog appears.

3. Navigate to the correct directory, name the file and click **Save**.

   The COMTRADE Export widow reappears with the new file name and directory.

4. Click the file type and *Include calculated channels,* if required.

5. Click **Export**.

New Graph/Setup

Use this dialog (Figure 3.18) to create or alter the appearance of the active graph by arranging the contents of the Channels Selected and Channels Available lists. In addition, the Phasor Display configures the phasor display ("Phasor Display Setup" on page 3-30).

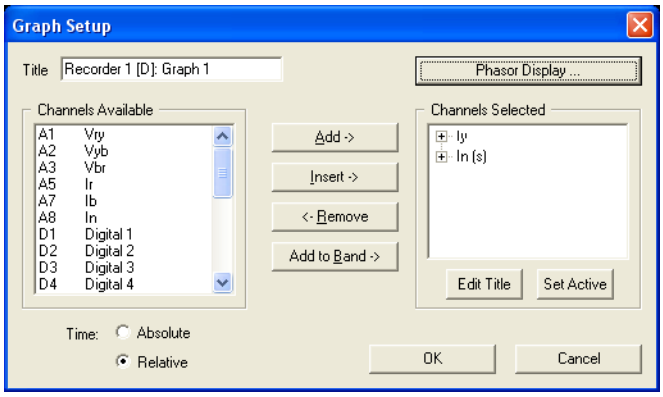

Figure 3.18 Graph Setup

Buttons and Fields

Title — Enter a unique title for a new graph or edit an existing graph name. This appears at the top of the graph window. It also appears under the Window menu. The active graph has a tick mark. The names for the default graphs are Analogs 1-8, Digitals 1-16 etc.

Channels available — Lists all the available analog and digital channel names.

Analog and digital channels are added in a similar way. The selected channels appear in the order that they are displayed. As new channels are added to the display they are appended to the Channels Selected list.

Insert — Inserts a selected Channels Available item above the Channel Selected item. One or more items can be inserted.

The digital channels are automatically interlaced with the analog channels. There can be up to two digital channels between each pair of analog channels.

Remove — Select a Channels Selected channel(s) and click this to remove a channel(s).

Overlay channels in a band

Overlays a number of analog channels on the same band.

If the channels in a band have different full scale values or units a warning message appears indicating that visual comparisons of magnitude are incorrect. When the cursors are used on a band containing more than one channel, only the active channel's measurements are shown and its name appears in bold text.

Set Active — Sets a selected channel as active. This can also be set using the "Band Settings" on page 3-7 or the "Right Click Menu" on page 3-14.

New Graph Operations

To add and configure a new graph:

1. Click to create a new graph or select *Graph > New Graph*.

The Graph Setup dialog appears (Figure 3.19) with no selected channels.

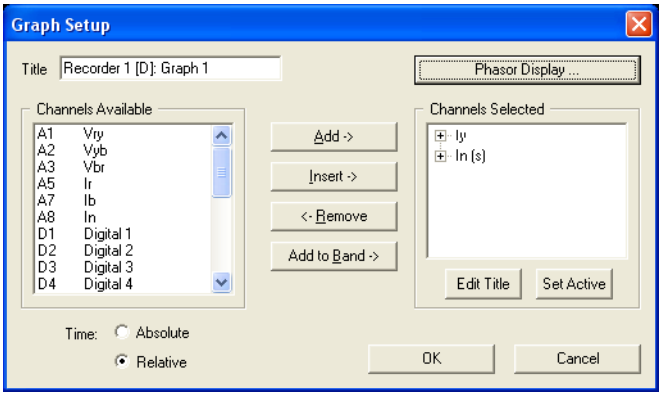

Figure 3.19 Graph Setup

2. Select a channel in the *Channel Available* and click **Add**.

3. Click a channel in *Channels Selected*, click a channel in *Channels available* and click **Add to Band** and it appears as a sub-item of that channel, if required.

NOTE

The channel selected as a band must be of the same type.

The band is given the name of the first channel added to it.

4. Select the name and click **Edit Title** and enter the new name, if required. Alternatively, double click on the text of the band's name.
5. Overlay a channel by:
   a. Add the first channel.
   b. Select the target band.
   c. Select all the required names from the *Channel Available* list.
   d. Click **Add to band**.
6. Select a channel and click **Set Active**, as required.
7. Click **Phasor Display** to configure this display ("Phasor Display Setup" on page 3-30).
8. Click **OK**.

Phasor Display Setup

Use this window (Figure 3.20) to display a number of phasor diagrams below the waveform display of a transient or disturbance record. These show the relative amplitudes and angles of three phase voltages and currents. The absolute length of the vectors is adjusted to use the most of the display. The values of RMS amplitude or angle can be superimposed on the display. Voltage vectors have an arrow head and current vectors have a circle.

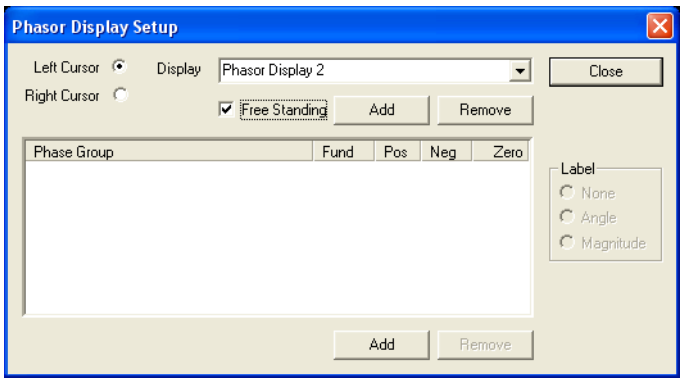

Figure 3.20 Phasor Display Setup

Buttons and Fields

Left cursor	Sets the dialog to list all the displays attached to the left cursor. New displays created while this selection is enabled are attached to the left cursor.
Right cursor	Sets the dialog to list all the displays attached to the right cursor. New displays created while this selection is enabled are attached to the right cursor.
Display selection	Select from the list of all displays attached to the selected cursor. The title of the display can be altered.
Add	Adds a new line to Display to title a new phasor.
Remove	Removes the selected phasor with confirmation.
Free standing	Activate and the display is drawn as an independent window. This option can also be enabled using the right-click menu ("Right Click Menu" on page 3-14) and disabled by closing the window.
Phase group list	Lists the names of the phase groups to be drawn in the selected display. Four columns contain either a ✔ or ✘ against the display options for each group. Click on the symbols to switch them on or off.
Label	Annotates the vectors: • *Angle* - annotates with their angle. • *Magnitude* - annotates with their RMS magnitude. • *None* - Switches annotation off.
Add a phase group	Adds a phase group so more than one phase group appear together. This is the Add button on the *bottom* of the window. The default vector that appears is the fundamental. Alternatively, the positive, negative or zero phase sequence can be shown. Any or all of the vector types can be shown together but it is advisable not to clutter the display with too many vectors. Instead create a new display for the different vector types.

Remove a phase group

Removes a phase group. This is the Remove button at the *bottom* of the window.

Phase Group and Phasor Operations

Phasor Displays

To add and configure a phasor display:

1. Click **Phasor Display** and the Phasor Display Setup dialog appears (Figure 3.21).

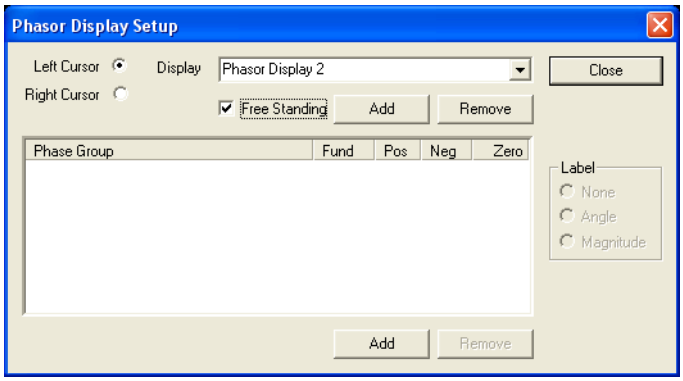

Figure 3.21 Phasor Display Setup - Before Configuration

2. Click **Add** at the top of the dialog.
3. Enter a *Display name* or select an existing phasor for modification.
4. Click **Add** on the bottom of the dialog.

   This lists the Channels selected from the Graph Setup dialog.
5. Add an extra phase group to an existing display by:
   a. Selecting the display from the drop down list at the top of the window.

      The phase group name and vector type(s) appear the list below.

b. Clicking **Add** at the bottom of the window and the Phase Group dialog appears (Figure 3.22).

Figure 3.22 Phase Group

c. Selecting the new phase group and vector type and click **OK**.

The default vector that appears is the fundamental. Alternatively, the positive, negative or zero phase sequence can be shown. To do this, click on the red cross below the selected vector. This changes to a green tick.

6. Select a *Phase Group* and click **OK**.

The Phasor Display Setup dialog reappears with the Phase Group added (Figure 3.23).

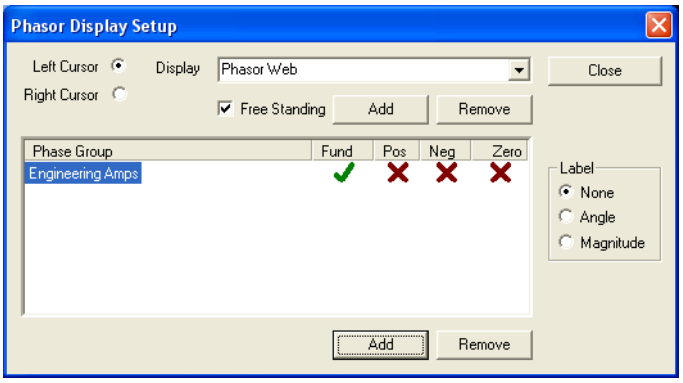

Figure 3.23 Phasor Display Setup - After Configuration

7. Click a **Label** radio button.

Click to toggle between activate/deactivate.

8. Click **Close**.

The Graph Setup dialog reappears.

9. Click **Close**.

To remove a phase group:

1. Select the display.
2. Click on the name of the phase group and click the **Remove** button at the *bottom* of the window.

   A dialog appears to confirm.
3. Click **Yes**.

Setup Colors

Use this dialog (Figure 3.25) to configure the color of each analog channel, as well as the text, background, phasor displays and digital inputs.

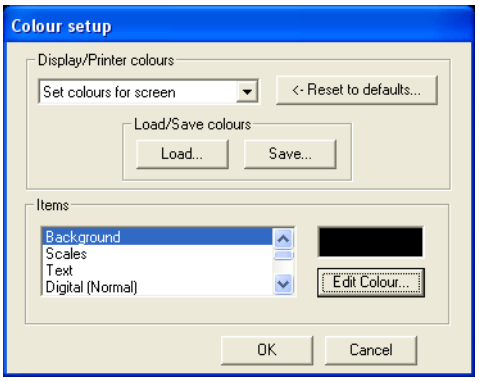

Figure 3.24 Colour Setup

Buttons and Fields

Display/Printer colours

List the color source settings.

Reset to defaults	Resets color section to system defaults for the printer: black text and waveforms on a white background.
Load	Loads settings from a *.col file.
Save	Saves settings to a *.col file.
Items	Lists items to which colors can be applied.
Edit Colour	Opens a standard Windows dialog box for color selection.

Color Configuration Operations

To configure colors:

1. Select *Graph* > *Color* and the Colour Setup dialog appears (Figure 3.25).

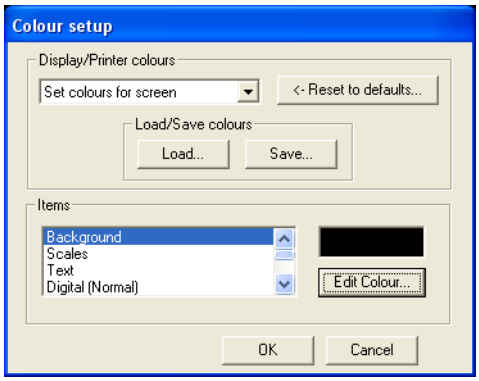

Figure 3.25 Colour Setup

2. Select *Display/Printer* colours using the drop down:
   - *Set colours for screen*
   - *Set colours for b&w printer*
   - *Set colours for colour printer*
3. Click **OK**.

To load a colour scheme:

1. Click **Load** and the Load Colour settings dialog appears.
2. Navigate to and select the .col file and click **Open**.

To save a colour scheme:

1. Click **Save** and the Save Colour settings dialog appears.
2. Navigate to the directory and enter a name and click **Save**.

NOTE

Name files *screen.col* and *printer.col* and they are loaded as the default colors when DSA is started.

To edit the color of a particular item:

1. Click a name in *Items*, then click **Edit Color**.
2. Click on a new color and click **OK**.

To create custom colors:

1. Click **Define Custom Colors**.

2. Use the power bar at the right of the dialog box to create a color and click **Add to Custom Colors**.

   The new color appears in the Custom colors area.

To set the color of analog channels:

1. Double-click on the channel name in the main window or select *Setup* on the channel's right-click menu and the Band Settings dialog appears (Figure 3.26).

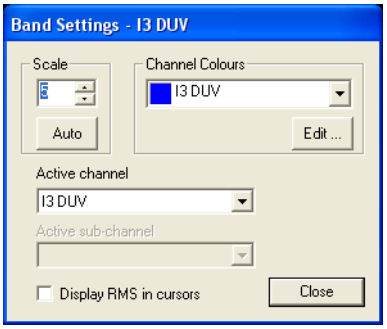

Figure 3.26 Band Settings

2. Click Edit, select a color and click **Close**.

Reclassify

When working with TR100 records it is necessary to classify the defined phase groups by providing additional information. If incorrect information has been entered for a record or a recorder, See "Older Records" on page 3-20 to reclassify them.

TR2000, TR100+ & PQR records contain explicit information as to the wiring of their phase groups. However, the type classification (voltage or current) is derived from the units defined for the channels in the respective groups. If this classification is in error, use Reclassify to override it. In this case the option to identify the phase group as *phase-to-phase* or *phase-to-neutral* is disabled.

NOTE

If a classification has already been provided for this specific record, any machine classification added in this way is ignored when the record is subsequently re-opened since the per-record classification has priority.

Print/Print Preview/Print Setup

Print Setup

To configure print setup:

1. Select *Graph* > *Print Setup* and a standard Print Setup dialog appears (Figure 3.27).

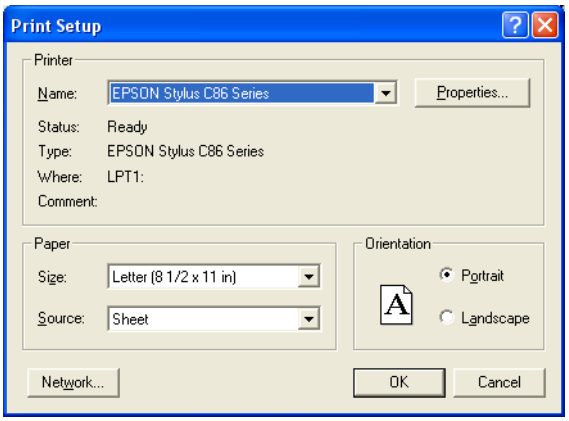

Figure 3.27 Print Setup

2. Click **Properties** to display printer-specific settings for configuration. The features available for configuration vary with the make of printer and the version of the driver software installed.

Print Preview

Use this window (Figure 3.28) to preview and print the graph.

Buttons and Fields

Print... Causes the graph as shown to be printed.

Next Page/Prev Page/Two Page

Disabled.

Zoom In Increases the size of the preview for detailed examination. Use the button twice to increase the magnification in two stages to its maximum.

Alternately, click directly on the preview image with the mouse, which displays the icon while over the display. This magnifies the image as before and also ensures that the resulting display is scrolled so that the selected point is visible.

Zoom Out Decreases the magnification, in two stages, until the whole page is visible.

If the preview is fully zoomed, clicking on it with the mouse cancels all zoom and restores the full page display.

Close — Closes the preview and restores the normal graph window display. Any PAT dialogs that had been hidden are now restored.

Print Preview Operations

To see a preview:

- Select *Graph* > *Print Preview*. The graph window changes to a graphical representation of the printed output.

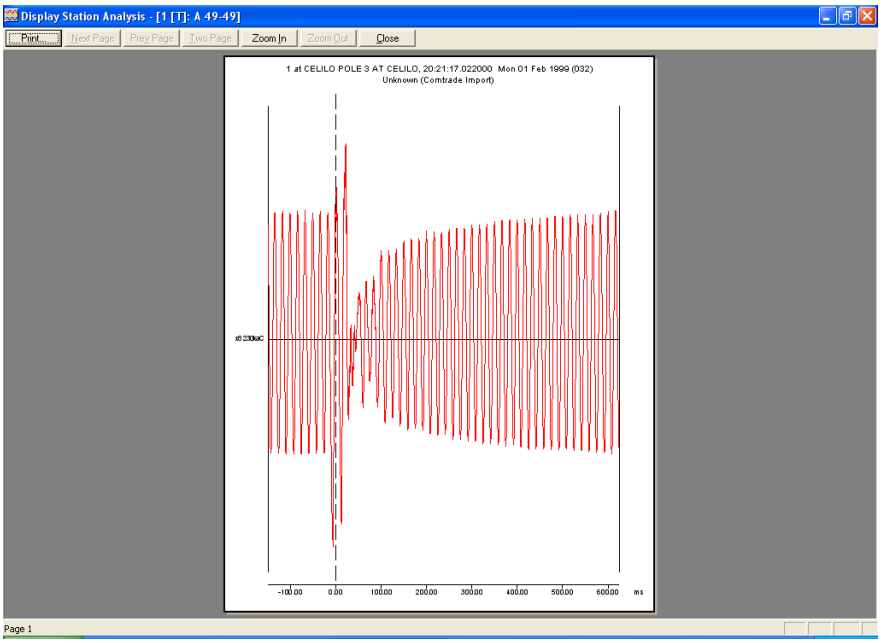

Figure 3.28 Print Preview

Print Graph

DSA32 uses the standard Windows® printer drivers, so most printer types can be used to print DSA32 graphs.

DSA expands the graph to the maximum allowed by the size of the paper.

The printed graph is similar to the screen display but includes:

- A header with the location and name of the recorder, the time and date of the record and the cause of the trigger.
- A comment field as a footer at the bottom of the page.
- Displayed cursors printed as solid lines.
- Trigger and end of trigger points printed as dashed lines.

The fonts used for the main display, the header and footer text are set in the Preferences dialog ("Preferences" on page 3-43).

The default color scheme for the printer output is black on white. See "Setup Colors" on page 3-34 to change to a color output.

Print Operations

To print a displayed graph either:

- Select *Graph > Print* or click  .

For more information on this consult Windows help.

Exit

To exit DSA:

1. Select *Graph > Exit* and DSA shuts down.

   If the option to automatically save graph layouts is selected in Preferences, the Save Layout ("Save Layout" on page 3-109) dialog appears for each open record.

2. Click **Yes**.

Edit Menu

This menu consists only of Copy.

Copy

This places a copy of the active graph on the clipboard for pasting into other applications, such as word processors.

The image placed on the clipboard is in the format used for printing the graph. It includes the header and footer text and uses the colors defined for printed output. Use "Print/Print Preview/Print Setup" on page 3-37 to see exactly what is sent to the clipboard.

The image is stored on the clipboard as an enhanced-format metafile. This is a device-independent format that retains shape and proportion on any output device as well as allowing it to be easily resized. If the application in use does not support this format you won't be able to paste in DSA32 screens.

Copy Operations

To copy a record:

- Select *Edit > Copy* to copy the active graph or click  .

View Menu

This menu consists of:

- ″Record Header″
- ″Analogue Profile″ on page 3-41
- ″Digital Profile″ on page 3-42
- ″Main Toolbar/Status Toolbar/Status Bar″ on page 3-43
- ″Preferences″ on page 3-43

Record Header

Use this window (Figure 3.29) as a strictly informational guide that gives the various header details of the active record. The type of record dictates what appears.

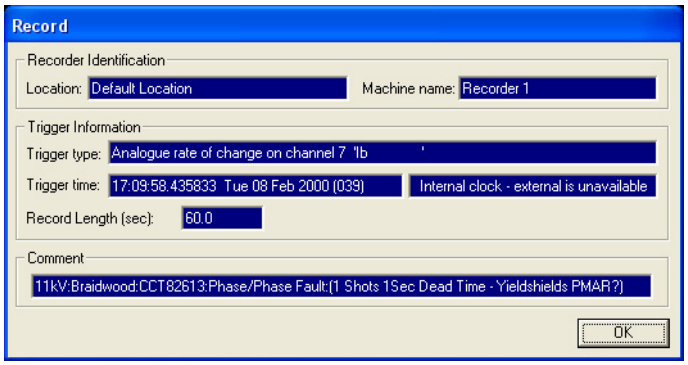

Figure 3.29 Record Header

Buttons and Fields

Recorder Identification

Provides the Location and Machine Name of the recorder that generated this record.

Trigger Information Lists the:

- *Trigger type*
- *Trigger time* - Presented as a 24 hour clock; date and day number along with an indication of the time synchronization status.
- *Record Length* - Given in cycles for transient records and in seconds for disturbance records.

Comment Presents any comment attached to the record.

Logger records only

Recorder Identification- Same as above.

Record Information Includes the:

- Start and end time of the logging period (time, date, day number)
- Interval between samples in the record
- Total length of time that the record covers.

View Record Header Operations

To open the record:

- Select *View > Record Header* and the Record dialog box appears (Figure 3.29).

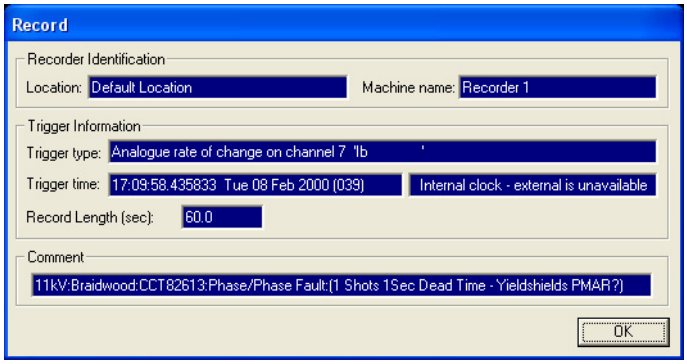

Figure 3.30 Record Header

Analogue Profile

Use this window (Figure 3.31) to list any analog profile information available for the record. For each channel pre-fault, immediate, final and post-clearance RMS values appear together with the defined unit. The:

- Pre-fault measurement is made on the cycle prior to the trigger point.
- Immediate measurement is made on the cycle after the trigger point.
- Final measurement is made on the cycle prior to the safety point.
- Post-Clearance measurement is made on the cycle after the safety point.

Records also contain maximum and minimum RMS values for each channel. The duration of the fault appears as the time from the trigger point to the start of the safety window.

Analogue Profile Operations

To open the Analogue Profile:

1. Select *View > Analog Profile* and the Analog Fault levels dialog appears (Figure 3.31).

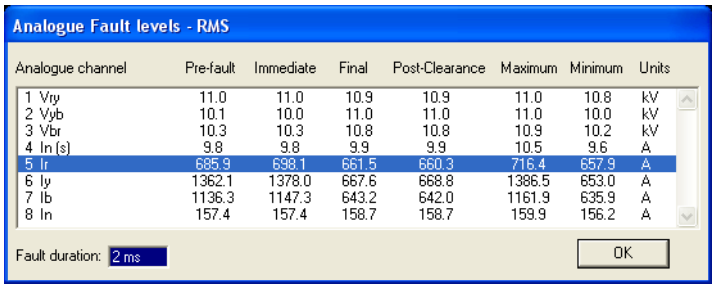

Figure 3.31 Analogue Profile

2. Select an analog channel and click **OK** and the recorder header dialog reappears.

Digital Profile

Use this dialog (Figure 3.32) to list the record's digital profile information. For each transition in the record the following appears:

- the channel
- the state to which it switched
- the time of the transition relative to the trigger time
- the duration of the fault. This is the time from the trigger point to the start of the safety window.

Digital Profile Operations

To open the Digital Transitions:

1. Select *View > Digital Profile* and the Digital Transitions dialog appears (Figure 3.32).

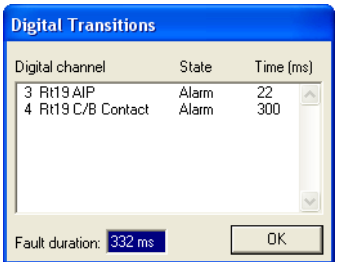

Figure 3.32 Digital Profile

2. Select a digital channel and click **OK** and the recorder header dialog reappears.

Main Toolbar/Status Toolbar/Status Bar

Hiding the toolbar may free up screen space which can be used to display graphs, this may be significant when DSA32 is run at lower resolutions.

To toggle these options on/off:

- Click the menu item.

A check appears next to the item when active.

Preferences

Use this window (Figure 3.33) to configure a number of DSA settings. These are automatically saved and are always used when DSA32 is running.

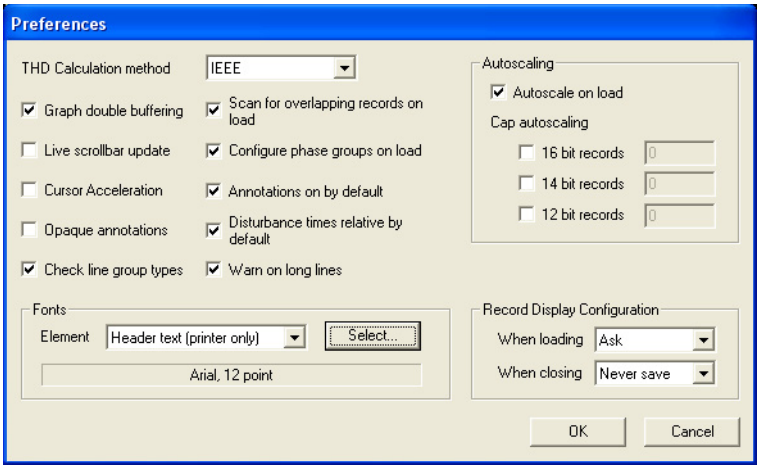

Figure 3.33 Preferences

Fields and Buttons

THD Calculation method

Select the Total Harmonic Distortion (THD), which is the ratio of the root of the sum of the squares of the harmonic amplitudes from two upwards to the amplitude of the fundamental voltage or current expressed as a percentage. There are two ways to express the amplitude of the fundamental:

- *IEEE* - Uses the true amplitude of the fundamental component. The IEEE function is defined in IEEE 1035 – 1989. For transient records it is calculated as follows:

$$THD = \left(\frac{\sqrt{\sum_{k=2} I_k^2}}{\sqrt{I_1^2}} \right) \times 100\%$$

For disturbance records it is calculated as follows:

$$THD = \sqrt{\left(\frac{V_{rms}}{V_{Fundamental}} \right)^2 - 1}$$

- ANSI - Uses the RMS value of the signal. The ANSI function is also used by CSA and IEC. For transient records it is calculated as follows:

$$THD = \left(\frac{\sqrt{\sum_{k=2} I_k^2}}{\sqrt{\sum_{k=1} I_k^2}} \right) \times 100\%$$

For disturbance records it is calculated as follows:

$$THD = \sqrt{\frac{V_{rms}^2 - V_{Fundamental}^2}{V_{rms}}}$$

For small values of THD, there is very little difference between the two values. For extreme levels of harmonics the IEEE scheme for THD can exceed 100%, but the ANSI method never can.

Graph double buffering

Enable this option and the graph display does not flicker when it is scrolled. It may slow the screen update speed on slower computers.

Live scrollbar update

Improves the update rate for slower computers. Enable this option and the cursor measurements at the left of a graph are updated when the graph is scrolled using the scrollbar. This may slow down the re-draw time for a slower computer.

Cursor Acceleration

Disable this option and using the keyboard arrow keys moves the cursors left or right one sample at a time. If there are many thousands of samples on the screen, the cursors move very slowly.

Enable this option and the cursors step multiple samples at a time. The size of the step is proportional to the number of samples currently on display so that the speed at which the cursors progress across the screen remains roughly constant, no matter how large the data set.

Whether or not to use acceleration depends on how keyboard control of the cursors is used.

If the cursors are normally positioned using the:

- Mouse and keyboard control is reserved for fine positioning, then turn acceleration off.
- Keyboard, then acceleration makes this less tedious with large records.

Opaque annotations

Enables/disables Opaque annotations. There are two ways to draw annotations on a graph window:

- *Transparent* - Draws text over whatever is already present on the screen. This has the advantage of reducing the degree to which they obscure the signal detail, however they can be harder to read.
- *Opaque* - Erase the portion of the graph where the text appears. These can obscure signal detail, but they are generally easier to read.

Scan for overlapping records on load

Enable this option and DSA32 searches the Display Station database each time a new record is loaded. This search identifies any records, which overlap the one being loaded. A marker appears in the horizontal axis of the graph window to indicate this fact (See "New Graph/Setup" on page 3-28). Disabling this option may improve load times on slower systems with many records.

Configure Phase Groups on load

Enables/disables configuration on load. For a non-TR2000, TR100+ or PQR record, the type of the phase groups are unknown. Before any power or impedance calculations are made the group type (V or I) and the VT type (p/p or p/n) must be confirmed (see "Older Records" on page 3-20). This can be done either when the record is first loaded or when a relevant calculation is requested. This need only be done the first time the record is opened, as the phase group information is saved back into the Display Station 32 database.

Annotations on by default

Enable this option and new graph windows are created with annotations visible. To suppress the drawing of annotations in a given graph window, use the Show Annotations option.

Disturbance times relative by default

Enable this option and the radio button in the Graph Setup dialog is set to Relative by default. If disabled, the default selection is Absolute. This determines if the horizontal time axis in the graph window shows the times in disturbance records either as offsets relative to the trigger point, or in absolute terms.

Check line group types

Enable this option and the units of the channels that make up the component phase groups for each line group are checked for consistency. If an error is detected an error message appears (Figure 3.34).

Figure 3.34 Check Line Group Types Error Message

Warn of long lines Enable this option and a warning occurs if long lines are discovered in a data record. This helps detect data records that are recovered over a network can have extra padding characters attached.

Autoscaling *Autoscale on load* **-** Enable this option and each analog input channel fills the available band. There are two rules that apply to this:

- Channels in the same phase group have the same scale factor
- There is a maximum scale factor depending on the recorder resolution

Disable this option and all channels are initially drawn with a scale factor of x1.

Cap autoscaling - Enable these options to define a maximum scale factor for each recorder resolution. The default values are:

Bits	Recorder	Max scale
16	TR2000 TR100+	x1000
14	PQR	x500
12	TR100	x100

A reason for disabling autoscaling is that very small induced currents are magnified and it may appear that a line is still energized when, in fact, it is not.

Record Display configuration

Enable these options to control the loading and saving of the graph layout. The exact look of a record can be saved and used again when the record is next opened. Layouts are saved for individual records only or for use on all records from a particular recorder.

When a record is loaded, the format is treated in three different ways:

- *Always restore* - Always use the previous display layout. DSA32 selects a layout by searching through those available in this order:
  - (1) Search for a default layout for that record - if that fails,
  - (2) Search for any layout for the record - if that fails,
  - (3) Search for a default layout for that recorder - if that fails,
  - (4) Search for any layout for the recorder - if that fails,
  - (5) Search for the default global layout - if that fails,
  - (6) Search for any global layout
  - If no layout is found, it uses the standard layout.
- *Never restore* - Always use the standard setup
- *Ask* - Prompt the user to select the layout. If no layouts exist, the standard setup is selected.

When a record is closed, the present display layout is in one of three ways:

- *Always save* - Always remember the layout for next time
- *Never save* - Never save the graph layout
- *Ask* - Prompt the user to save the layout.

If the setup is Always saved it is used as the default layout for that record only.

There are a number of ways this facility can be configured:

- The default is to Ask on load and Never save on close. This gives maximum control to you, as the layout is only saved through explicit use of the Save Layout menu option. When loading a record, you select any of the available layouts, or elect to use none of them.
- Selecting Always close and Always restore results in layouts being saved and restored transparently without your knowledge. The end result is that each record viewed has its layout saved and exactly that layout is automatically restored when the record is reopened. You can save a per-machine layout that acts as a template for all records from that machine the first time they are opened. As they are closed they receive their own layout that they use thereafter.
- Selecting Never restore and Never save effectively turns off this feature.

Report fonts

Enables the Graph print option to add a header and footer to the printed output. The font and size of the print is selected independently for the header, footer and body text. The current font selections are given in the titles of the three buttons at the bottom of the dialog. Clicking on any one opens a standard font selection dialog from which a new font is specified. The font *style* specification is ignored by DSA32.

The body font is also in the on-screen display but a newly selected font is only used in graphs created after the change.

Preferences Operations

To configure preferences:

1. Select *View > Preferences* and the Preferences dialog appears (Figure 3.35).

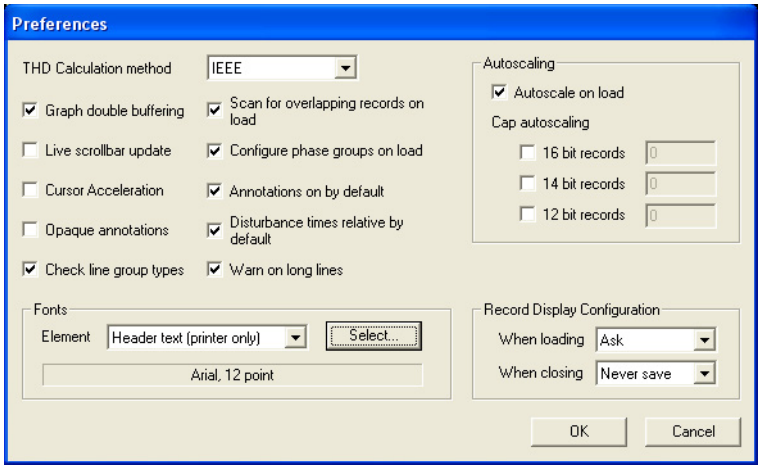

Figure 3.35 Preferences

2. Select the *THD Calculation method*.

3. Click any of the ten check boxes underneath *THD Calculation method*, as required.

4. Click **Auto scale on load**, if required.

5. Click **Cap autoscaling** check boxes, as required.

6. Select an *Element* from the drop down.

NOTE

Click Select in the Fonts area and the Font dialog appears to select font specifications.

7. Select *When loading* and *When closing preferences* from the drop down in Record Display Configuration area.

8. Click **OK**.

NOTE

You must exit DSA for some settings to take effect.

Power Analysis Toolkit (PAT) Menu

The Power Analysis Toolkit (PAT) is a calculation module for DSA32. A wide range of values can be calculated for individual channels and phase groups. There are a number of icons on the PAT toolbar ("Main Toolbar/PAT Toolbar" on page 3-17) for implementing the power calculations. These are also available under the menu. The functions available depend on the record type and whether you are connected.

As an alternative, the values can be computed over the entire length of the record. These new channels can be added to the graph display. For more information on this see "Channels Menu" on page 3-66.

The PAT functions are:

- Peak, RMS & PU levels
- Form, crest & quality factors
- Harmonic content & THD
- Frequency
- Positive, negative and zero sequence components
- Apparent, real & imaginary power
- Power factor & X/R ratio

The values computed are for the parts of the signals that lie between the two cursors so these must be enabled for data to appear. While a PAT window is active you can alter the positions of the cursors in DSA32 and PAT recomputes and displays the new data. PAT automatically adjusts the right hand cursor to give an integer number of cycles between the cursors.

NOTE

If the graph is zoomed to the extent that less than a cycle of data is visible, this adjustment is impossible - a warning appears.

This menu consists of:

- "Fundamental Frequency"
- "Single Channel" on page 3-53
- "Power" on page 3-55
- "Sequence Components" on page 3-60
- "Harmonics" on page 3-63

Fundamental Frequency

Use this window (Figure 3.36) to designate the channel for determining the system frequency.

NOTE

Set the System Frequency before selecting the other functions.

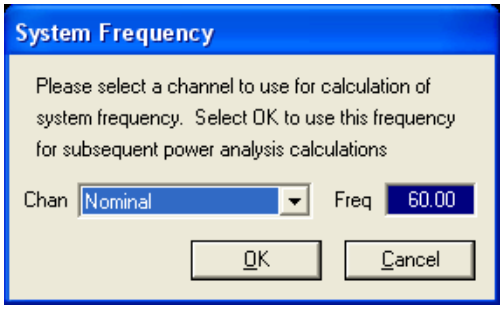

Figure 3.36 System Frequency

To calculate the harmonics, sequence components and power accurately the actual system frequency is required. DSA32 can obtain this from the pre-trigger portion of a selected channel. The best signal to use is an unfaulted voltage channel.

If no channel is selected for frequency measurement, or the special Nominal entry is selected, the nominal value specified in the record is used (50.0/60.0 Hz). This correction is quite small for normal system frequency variations. The closer the actual frequency is to the nominal value, the smaller the correction factor.

When DSA32 is started, the default is to use the nominal frequency.

Buttons and Fields

Chan	Select the channel to calculate the harmonics, sequence components and power.
Freq	Displays the calculated system frequency.

System Frequency Operations

To designate the channel:

1. Select *PAT > Fundamental Frequency* or click  .

   The System Frequency dialog appears (Figure 3.37).

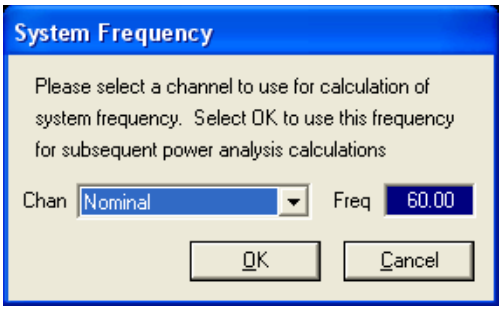

Figure 3.37 System Frequency

2. Select the *Chan*.

   The frequency obtained for that entry appears to the right.

3. Click **OK**.

Single Channel

Use this window (Figure 3.38) to display a number of computed values for a specified channel.

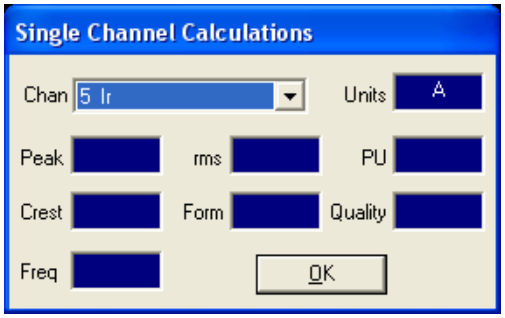

Figure 3.38 Single Channel Calculations

If the Print Preview is active for an active graph, it is hidden until the preview is closed.

Buttons and Fields

Chan	Select the channel. All channel names are available, not just the ones presently displayed in DSA32.
Peak	Displays the maximum positive or negative value between the cursors. If the maximum excursion is negative then the value is negative.
RMS	Displays the true root mean square value of the signal assuming an exact number of samples per cycle.
PU	Displays the ratio of the RMS value to the nominal value of the channel as defined in the recorder configuration.
Crest (peak factor)	Displays the ratio of the peak value to the RMS value. For a pure sine wave the ratio is 1.414.
Form	Displays the ratio of the RMS value to the mean value. For a pure sine wave the ratio is 1.111.
Quality	Displays the percentage difference between the absolute area under the signal compared with a pure sine wave with the same peak amplitude. This is the value that is used for sub-cycle triggering in the TR100 and DL8000.
Frequency	Displays the measurement made by first filtering the data with a 12 pole low pass filter, then measuring the distance between successive zero crossings. For low level signals (i.e. load level current) the accuracy of this measurement may be degraded. A minimum of two cycles between the cursors is required to measure frequency.

Single Channel Operations

To use single channel calculations:

1. Ensure cursors are active. All PAT calculations are carried out on the samples between the cursors. If the cursors are not active, no values appear.
2. Select *PAT > Single Channel* or click  and the dialog appears (Figure 3.39).

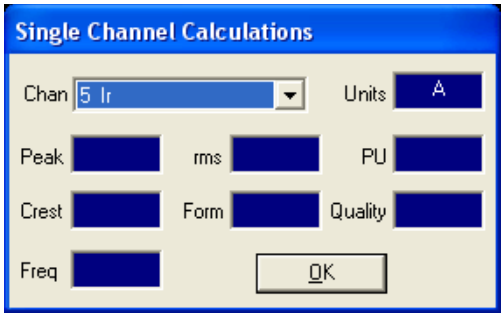

Figure 3.39 Single Channel Calculations

3. Select the *Chan*.

   The values obtained for the entries appear.

4. Click **OK**.

Power

Use this window (Figure 3.40) to configure parameters for and view power calculation results for specific channels. Additionally, you can configure aspects of the Phase Groups.

If the Print Preview is active for an active graph, it is hidden until the preview is closed.

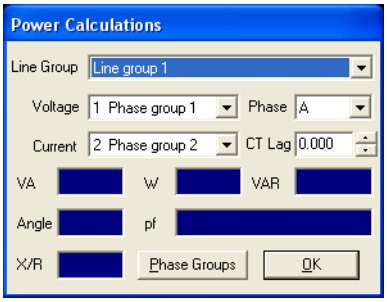

Figure 3.40 Power Calculations

All power calculations are performed on the fundamental phasors extracted from the source channels using the method described in "Single Channel Quantities" on page 3-73.

Per Phase Apparent Power

Apparent power is calculated as the product of the RMS magnitude of the voltage and current phasors:

$$S_A = \frac{|V_A|}{\sqrt{2}} \frac{|I_A|}{\sqrt{2}}$$
$$S_B = \frac{|V_B|}{\sqrt{2}} \frac{|I_B|}{\sqrt{2}}$$
$$S_C = \frac{|V_C|}{\sqrt{2}} \frac{|I_C|}{\sqrt{2}}$$

Per Phase Reactive Power

Reactive power is calculated as the product of apparent power and the sin of the phase angle:

$$Q_A = S_A \sin(\theta)$$

The phase angle is calculated as the raw angle difference between the two phasors plus the specified correction value for CT lag.

Per Phase Real Power

Real power is calculated as the product of apparent power and the cos of the phase angle:

$$P_A = S_A \cos(\vartheta)$$

The phase angle is calculated as for reactive power above.

Total Power in Star (Phase-Neutral) Systems

The total system power in phase-neutral configurations is calculated by simply summing the three per phase power values. These are calculated as above.

Total Power in Delta (Phase-Phase) Systems

Total system power in phase-phase configurations is calculated by the two-wattmeter method:

Real

$$P_{ab} = |V_{ba}||I_a|\cos(\vartheta)$$
$$P_{cb} = |V_{bc}||I_c|\cos(\varphi)$$
$$P_t = P_{ab} + P_{cb}$$

Reactive

$$Q_{ba} = |V_{ba}||I_a|\sin(\vartheta)$$
$$Q_{bc} = |V_{bc}||I_c|\sin(\varphi)$$
$$Q_t = Q_{ba} + Q_{bc}$$

Apparent

$$S_t = \sqrt{P_t^2 + Q_t^2}$$
$$= \sqrt{V_{ba}^2 I_a^2 + V_{bc}^2 I_c^2 + 2V_{ba}I_aV_{bc}I_c\cos(\vartheta - \varphi)}$$

where,

- Θ - phase angle between V_{ba} and I_a
- ϑ – Phase angle between V_{bc} and I_c

Buttons and Fields

Line Group — Select the line group used for the calculations. When working with TR100, TR1600 or COMTRADE records there are no line groups defined for the record.

Voltage/Current — Select the voltage and current phase groups for use in the power calculations or click Phase Groups to define new ones.

Displays — Shows the calculated apparent, real and imaginary power figures for each phase with the power factor. This uses the amplitude and phase of each of the vectors computed from the selected voltage and current channels so only the fundamental components are used to compute power.

The phase angle, power factor and X/R ratio (the ratio between the reactance and the resistance of the load) also appear.

Each power component is displayed in RMS form.

CT Lag — Select the lag. Where interposing CTs are used to measure current a correction can be made for the CT phase lag. Enter the value use the spinners. The lag angle is in degrees and fractions of a degree.

For a TR2000 record the type of VT is known but for other recorders the type must be declared before the power and impedance calculations are made. For a TR2000 the CT correction defined in the recorder is used as the default.

Power Calculations Operations

To use power calculations:

1. Ensure cursors are active. All PAT calculations are carried out on the samples between the cursors. If the cursors are not active, no values appear.
2. Select *PAT > Power* or click  and the dialog appears (Figure 3.39).

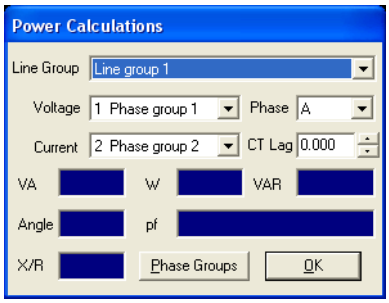

Figure 3.41 Power Calculations

3. Select a *Line Group,* if required.
4. Select *Voltage* and *Current* phase groups when working with TR100, TR1600 or COMTRADE records.
5. Select a *Phase*.
6. Select or enter a *CT Lag*, if required.
7. Click **Phase Groups** and the dialog appears (Figure 3.42).

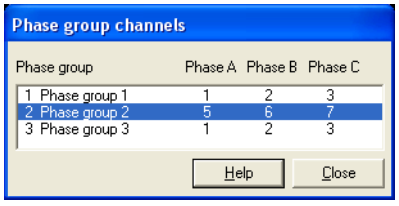

Figure 3.42 Phase group channels

8. Configure the *Phase group channels* by:

a. Clicking **Phase group** and the dialog appears (Figure 3.43).

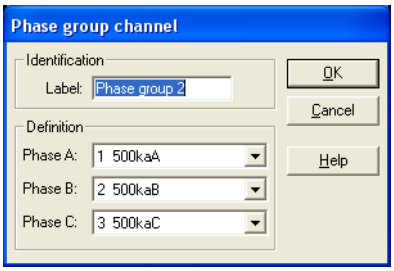

Figure 3.43 Phase group channel

b. Enter a *Label*.

c. Select *Definitions* for all phases.

d. Click **OK**.

The Phase group channels dialog reappears.

e. Click **Close** and the Power Calculations dialog reappears.

9. Click **OK**.

Sequence Components

Use this window (Figure 3.44) to configure parameters for and view sequence component calculation results for specific channels. Additionally, you can configure aspects of the Phase Groups.

If the Print Preview is active for an active graph, it is hidden until the preview is closed.

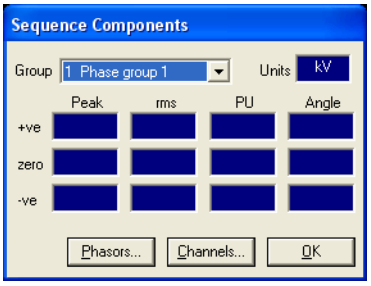

Figure 3.44 Sequence Components

Sequence components are calculated for a phase group of three channels. For each sample in these three channels a phasor of the fundamental harmonic is calculated using the method described in "Single Channel Quantities" on page 3-73.

For each sample vector arithmetic is used to generate the sequence components:

$$I_{R0} = \frac{1}{3}\left(I_R + I_Y + I_B\right)$$

$$I_{R1} = \frac{1}{3}\left(I_R + aI_Y + a^2 I_B\right)$$

$$I_{R2} = \frac{1}{3}\left(I_R + a^2 I_Y + aI_B\right)$$

where:

I_{R0}	Zero sequence component
I_{R1}	Positive sequence component
I_{R2}	Negative sequence component
I_R	Red phase vector
I_Y	Yellow phase vector
I_B	Blue phase vector

a	Unit vector $\left(-0.5, i\frac{\sqrt{3}}{2}\right)$

Buttons and Fields

Group	Select the phase group used for the sequence component calculations or click Phase Groups to define new ones.
Displays	Displays the amplitude and phase angle of the fundamental component of each channel is calculated and the positive, zero and negative sequence components computed using vector addition with positive, zero and negative 120° phase rotation. The phase angles are relative to that of the first channel in the phase group.
Phasors	Opens the vector phase display, which shows the relative phases of the three channels in the phase group. The absolute angle is that relative to the position of the left hand cursor. This display is particularly useful when the display cursors are moved from pre-fault into post-fault where the relative phase angles may vary. Use the check boxes at the bottom left to draw circles for the locus of each vector. Use this to check relative amplitudes and the identity of each vector.

Sequence Components Calculations Operations

To use sequence components calculations:

1. Ensure cursors are active. All PAT calculations are carried out on the samples between the cursors. If the cursors are not active, no values appear.

2. Select *PAT > Sequence Components* or click  and the dialog appears (Figure 3.45).

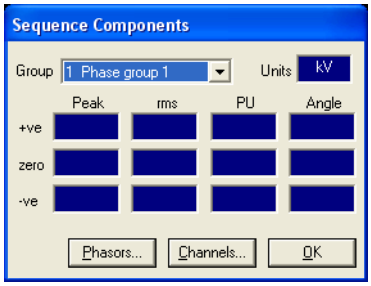

Figure 3.45 Sequence Components

3. Select a *Group* and the display fields are populated.
4. Click **Phase Groups** and the dialog appears (Figure 3.42).

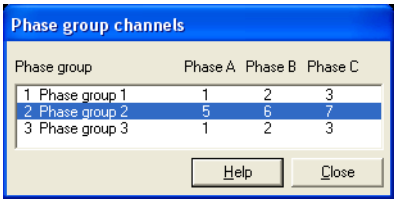

Figure 3.46 Phase group channels

5. Configure the *Phase group channels* by:
   a. Clicking **Phase group** and the dialog appears (Figure 3.47).

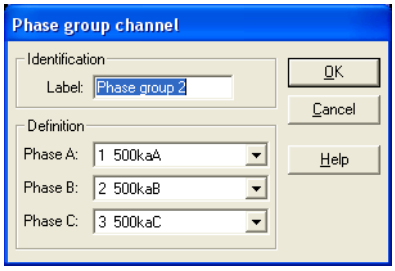

Figure 3.47 Phase group channel

   b. Enter a *Label*.
   c. Select *Definitions* for all phases.
   d. Click **OK**.

   The Phase group channels dialog reappears.

   e. Click **Close** and the Sequence Components dialog reappears.

6. Configure the *Phasors* by:

   a. Clicking **Phasor** and the dialog appears (Figure 3.48).

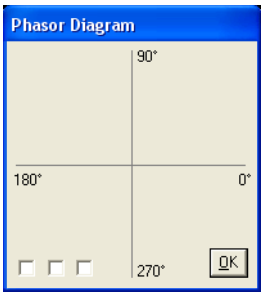

Figure 3.48 Phasor Diagram

   b. Manipulate the diagram using the three check boxes.

   c. Click **OK**.

   The Sequence Components dialog reappears.

7. Click **OK**.

Harmonics

Use this window (Figure 3.49) to configure parameters for and view harmonic results for specific channels.

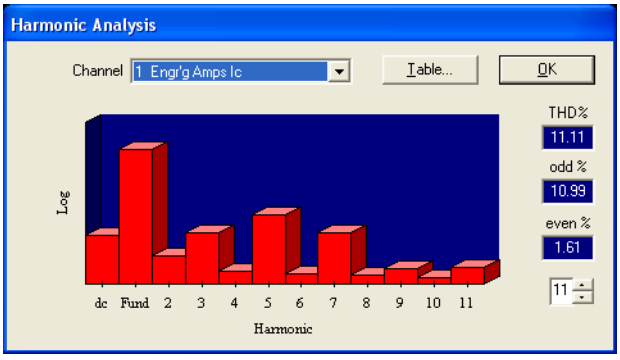

Figure 3.49 Harmonics Analysis

If the Print Preview is active for an active graph, it is hidden until the preview is closed.

Buttons and Fields

Channel	Select the channel and this measurement uses a discrete Fourier transform (DFT) technique to compute the amplitude and phase angle of each harmonic of the fundamental including the zeroth (DC component). The accuracy of the results suffers with low level input signals.
Histogram Scale	Contains a logarithmic vertical scale to make small levels of harmonics visible.
Harmonics Spinner	Varies the actual number of harmonics. To ensure an accurate measurement there should be at least four samples per cycle of the harmonic waveform. PAT limits the maximum harmonic to one quarter of the sampling rate; i.e. for a sampling rate of 9600 on a 50Hz signal the maximum harmonic is the 48th.
THD%	Displays the ratio of the power in the harmonics from the second upwards relative to the fundamental. THD figures for the odd and even harmonics only appear. There are two different standards for computing THD, which are selected in "Preferences" on page 3-43. THD values are calculated using as many harmonic values as are available. Initially, the dialog displays calculations based on values up to the 11th harmonic. If this limit is increased, then the THD calculations can be refined with the new values. If the number of harmonics is subsequently reduced, the THD values are not restored to their former values. Instead the more accurate results, incorporating the greater number of harmonics, are retained.
Table	Opens the Table dialog with more accurate tabular results. This gives a list of the amplitudes and phase angles of the harmonics over 0.1% of the fundamental. The amplitudes are peak magnitude values and the angles are relative to the fundamental angle.

odd %/even % Display data when the active record contains disturbance data. Higher harmonic values cannot be obtained and so the main histogram display is removed. The odd and even harmonic distortion values are similarly unavailable. However, a total harmonic distortion value still appears. See "Preferences" on page 3-43 for details of how it is derived.

Harmonics Operations

To use harmonics calculations:

1. Ensure cursors are active. All PAT calculations are carried out on the samples between the cursors. If the cursors are not active, no values appear.
2. Select *PAT > Harmonics* or click  and the dialog appears (Figure 3.50).

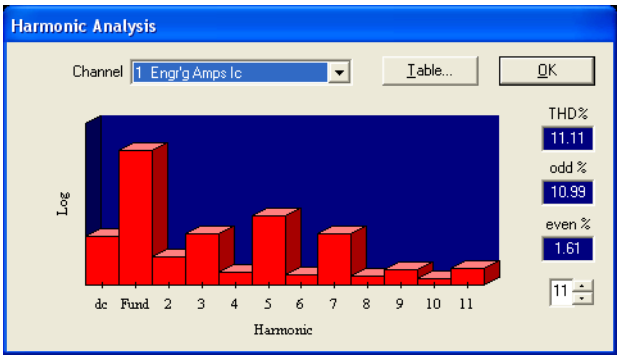

Figure 3.50 Harmonics Analysis

3. Select a *Channel* and the display fields are populated.
4. Use the spinners to select a number of harmonics.
5. Click **Table**, if required, and the dialog appears (Figure 3.51).

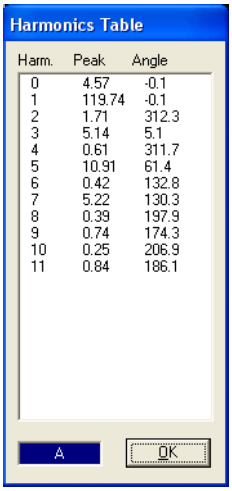

Figure 3.51 Harmonics Table

6. Click **OK** and the Harmonics Analysis window reappears.
7. Click **OK**.

Channels Menu

This menu consists of:

- ″Combined Channels″ on page 3-68
- ″Single Channel Quantities″ on page 3-73
- ″Average″ on page 3-75
- ″Sequence Components″ on page 3-77
- ″Star/Delta Conversion″ on page 3-80
- ″Line Group Quantities″ on page 3-85
- ″Phase Group Angles″ on page 3-89
- ″Differential Phase Angle″ on page 3-91
- ″New Phase Group″ on page 3-93
- ″Import Channels″ on page 3-95
- ″Synchronize Imports″ on page 3-97
- ″Long Term Flicker (Plt)″ on page 3-100

Computed Channels

The Power Analysis Toolkit (PAT) functions allow for a wide range of measurements on the voltage and current signals. There are also functions that allow the generation of computed quantities over the entire length of a transient or disturbance record. These appear as extra channels that are displayed, measured and printed just like the input voltage and current channels. These new channels are then used in turn to compute further complex channels.

The computed channels are divided into six different groups:

- *Combined channels* – Simple arithmetic sum and difference functions
- *Single channel quantities* – RMS, frequency & harmonic content of one channel
- *Sequence components* – Positive, negative and zero sequence of a phase group
- *Star/Delta conversion* – Compute the equivalent voltage signals
- *Line group quantities* – Watts, VARs, VA, ...
- *Phase group angles* – Voltage & current phase angles

Once a new channel has been created it can be added to the current view using *Graph > Setup.* The channel can then be selected and added to the display in the normal way.

When a new channel is created it is assigned a full-scale deflection value for the purposes of vertical scaling. This value is limited by the full-scale deflections of the input channels so that the result is not artificially scaled beyond the margin of error inherent in the source signals. Thus, in most cases, the computed channel's full-scale deflection will only differ from that of the source channels when it contains a value that lies outside the source's full-scale.

A line group is a pair of phase groups, one voltage and one current, defined in the record.

Add to graph

Each computed channel window has this check box. If it is:

- Unchecked DSA32 displays an informational alert when the new channel is created. It is necessary to select *Graph > Setup* to incorporate the new channel into an existing graph. Alternatively, select *Graph > New Graph* to create a new graph including the computed channel.
- Checked, then the newly generated channel is immediately added to the active graph without any need to use Setup. No alert appears.

This check box setting is *sticky*. It retains its setting between uses of any of the computed channel dialogs. If it is set in the Combined Channel window, then the next time that dialog is used the check box is in the same condition as it was left previously. The setting is universal across all the computed channel dialogs. If it is in the Combined Channel window it is the same in Single Channels Quantities. In addition, when DSA32 is shut down the current Add to graph setting is recorded for use when it is restarted.

Combined Channels

Use this window (Figure 3.52) to combine channels. A combined channel is produced from a simple arithmetic function of one, two or three channels. The three functions are *sum*, *difference* and *inverse*. The summation of three phase voltages or currents is used to compute a neutral channel. The inverse is used to correct an inverted CT. In this case, a new phase group can be created to include the new channel. Sum and difference calculations are used to compute the missing phase if only two phase and neutral channels are available.

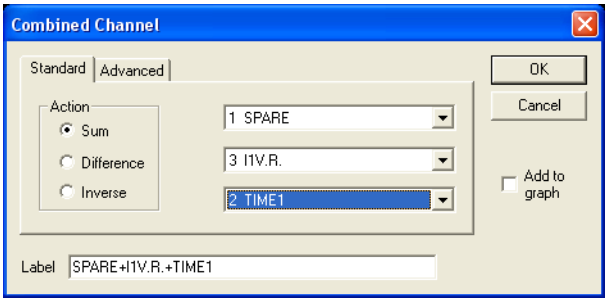

Figure 3.52 Combined Channels - Standard Tab

Buttons and Fields

Action	Click on Sum, Difference or Inverse. For disturbance channels, in which each sample consists of both an RMS value and a fundamental phasor, Sum adds the corresponding RMS values as normal and also performs a vector addition on the phasor quantities. Similarly, Difference performs simultaneous arithmetic and vector calculations. When inverting a disturbance channel the RMS value is left unaltered since RMS is an inherently positive quantity, however the phasor is *inverted* by means of a 180° rotation. When performing a difference on disturbance channels the possibility of negative RMS results is unavoidable - in such cases DSA32 automatically extends the display range of the resultant channel to reflect its bipolar character.
Sum	Identify either two or three channels.
Difference	Identify two channels. For the difference of two channels, the first signal is subtracted from the second. For a transient record this would have the same result as inverting the first channel then adding it to the second.
Inverse	Identify one channel is required.
Channel	Select a channel from the drop down.
Label	Select the channels for the operation and DSA32 dynamically produces a default label for the new channel. Enter a new label, if desired. The label should be descriptive of its contents; i.e. *I neutral* or *-Ir*. Use up to 25 characters but it is best to keep the label short for display reasons. The default labels are commonly long and abbreviation is often recommended.
Add to graph	Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Advanced Tab

Figure 3.53 shows the Advanced tab.

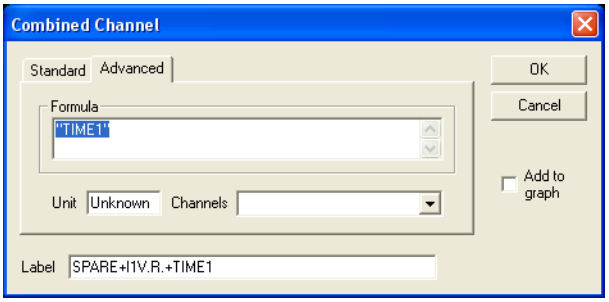

Figure 3.53 Combined Channels - Advanced Tab

Formula

Enter an arbitrary formula describing the required output. Since any text can be entered, take care to enter a meaningful expression before it is accepted for processing. Essentially, any mathematical expression involving the four basic arithmetic operators is usable along with parentheses to control the order of evaluation.

Valid formulae consist of the following elements:

- *Channels* - channels from the active record are referenced by entering their labels enclosed within quotes, e.g. "Vry".
- *Constants* - integer or floating point values are entered in the normal way, e.g. 5.2
- *Arithmetic operators* - Either + (addition), - (subtraction), / (division) or * (multiplication).
- *Parentheses* - portions of the formula that constitute a valid expression in their own right can be enclosed in parentheses to ensure that they are evaluated first.

Examples are:

- *"Vry"+"Vyb"+"Vbr"*
- *"Vry"+4.9*
- *("Vry"*2)+"Vrb"*

Operator Precedence

In the absence of parentheses the operators are evaluated with standard rules of precedence. Multiplications and divisions are evaluated first followed by additions and subtractions. Within these constraints operators are evaluated left to right as they are encountered.

Nesting

When using parentheses expressions can be nested, e.g. *(("Vry"*2)+"Vrb")/2*. There is no limit on the level of nesting.

Division by zero

Formulae involving division run the risk of encountering data that gives rise to a division by zero. Such calculations are trapped and the result for those points is set to zero. An error message occurs if divisions by zero occur during a given calculation.

Divisions by zero are encountered less often than might be expected. For example, division by a sinusoidal quantity typically does not trigger a division by zero every time the signal crosses the y axis. This is due to the fact that the channel data is made up of discrete values sampled at regular intervals. In many cases the nearest samples are found on either side of the zero crossing. Only where a sample has been taken exactly on the point of transition does a divide by zero arise.

Unit

Enter a unit label. Because of the absolute flexibility allowed in generating new quantities there is no simple way for the application to determine what the appropriate units are for the new channel. By default Unknown appears. It is important to supply the correct unit if the new channel is to be utilized in further operations, such as inclusion in a phase group.

Channels	Select a Channel for use. When constructing a formula it is necessary to enter the exact name of one or more channels from the current record, a procedure that is tedious and error prone. To minimize this problem, the *Channels* drop down presents all the analog channels in the record - select one and its name, enclosed in quotation marks, is inserted at the current cursor position in the formula field.
Label	Enter a descriptive label for the channel being created. Since any formula can be entered, transforming the input quantities in any number of ways, it is not possible to present a meaningful default label for these channels.
Add to graph	Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Combined Channels Operations

To produce a combined channel:

1. Select *Channels > Combined Channels* and the Combined Channel dialog appears (Figure 3.54).

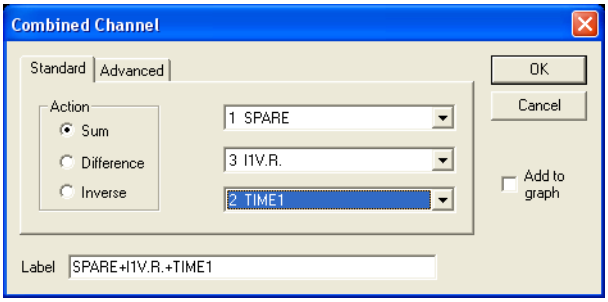

Figure 3.54 Combined Channels - Standard Tab

2. Configure the *Standard* tab by:
   a. Selecting up to three channels using the drop downs.
   b. Click an *Action* radio button.
   c. Enter a *Label*.

3. Configure the *Advanced* tab (Figure 3.55) by:
   a. Selecting a channel from *Channels*.
   b. Enter a *Unit* name.
   c. Enter a *Formula*.

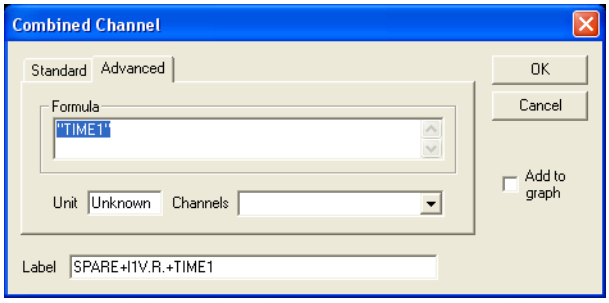

Figure 3.55 Combined Channels - Advanced Tab

4. Click **Add to graph**, as required.
5. Click **OK**.

   A confirmation dialog may appear.
6. Click **OK**.

Single Channel Quantities

Use this window (Figure 3.56) to enable a number of functions based on a single channel input. These are:

- RMS
- Frequency
- Harmonic content

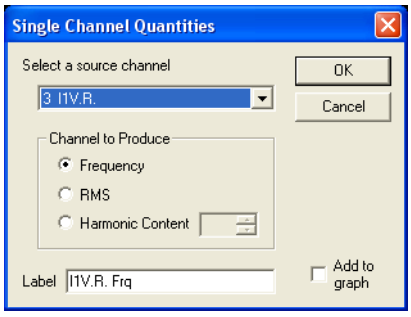

Figure 3.56 Single Channel Quantities

The RMS is calculated using a one cycle sliding window and then uses five cycles of information for smoothing.

Buttons and Fields

Select a source channel

Select the source channel for use.

Channel to produce

Frequency/RMS Click to select that channel type.

Harmonic Content Click the radio button and select the actual harmonic number using the spinners. A value of zero extracts the DC component and one is the fundamental component. The maximum harmonic number is limited to one quarter of the sample rate; i.e. for a sample rate of 9600 samples per second on a 50Hz signal the top harmonic is the 48th. Harmonic content cannot be produced from disturbance or logger channels.

The harmonic values are generated using a Discrete Fourier Transform. The DC component is the zeroth harmonic and the fundamental is the first. The formula is:

$$\frac{2}{N}\sum_{k=0}^{N-1} x_{k+r}\{\sin(2\pi kh/N) - j\cos(2\pi kh/n)\}$$

where:

- N = number of samples per cycle
- h = desired harmonic
- r = first sample number of cycle

Label DSA creates a label for the new channel as the criteria are specified. Enter a name to alter or replace the provided value. Make the label descriptive of its contents; i.e. *Ir rms* or *Vr freq*. Enter up to 25 characters but keep the label short for display purposes.

Add to graph Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Single Channel Quantities Operations

To configure this:

1. Select *Channels > Single Channel Quantities* and the dialog appears (Figure 3.57).

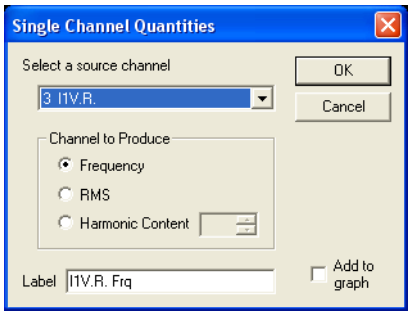

Figure 3.57 Single Channel Quantitates

2. Select a channel from *Select a source channel*.
3. Click a *Channel to Produc*e radio button:
   - **Frequency**
   - **RMS**
   - **Harmonic Content** - use the spinner to set the number of harmonics.
4. Enter a *Label*.
5. Click **Add to graph**, as required.
6. Click **OK**.

   A confirmation dialog may appear.
7. Click **OK**.

Average

Use this window (Figure 3.58) to produce an averaged channel. The channel is created using a moving window average of specified width across the length of the record. Values cannot be computed in two regions half the moving window's width at the start and end of the record. These portions are filled in with the nearest available calculated result.

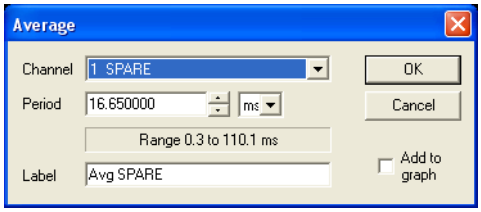

Figure 3.58 Average

Buttons and Fields

Channel — Select an analog channel whose values are averaged to create the new channel.

Period — Use the spinners to determine the width of the moving window for creating the average. It defaults to the period of the current record, for example, 20ms for a 50Hz transient record. The range of permissible values extends from the shortest, which contains just three samples to the longest, which is half the record length. The period time must be an exact multiple of the duration of a single sample.

Use the spinners to alter the period in the smallest possible steps. Alternatively, enter a period directly, but as the focus leaves this field, it is changed where necessary to the nearest value that is an exact multiple of the sample duration.

Unit — Use the drop down to enter the unit. A unit appropriate to the duration of the record is selected by default but can be changed. Units ranging from microseconds to minutes can be used to make the period values more manageable.

Label — Enter a label for the new channel. A default label is provided based on the name of the input channel but this can be changed.

Add to graph — Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Average Operations

To configure this:

1. Select *Channels* > *Average* and the dialog appears (Figure 3.59).

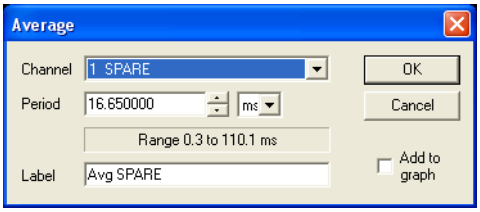

Figure 3.59 Average

2. Select a *Channel*.
3. Use the spinners to set the *Period*.
4. Use the drop down to set the unit.
5. Enter a *Label*.
6. Click **Add to graph**, as required.
7. Click **OK**.

   A confirmation dialog may appear.
8. Click **OK**.

Sequence Components

Use this window (Figure 3.60) to produce a sequence component computed channel. The computations possible are to compute the positive, negative or zero sequence components of a selected phase group. The amplitude can be plotted in a number of units.

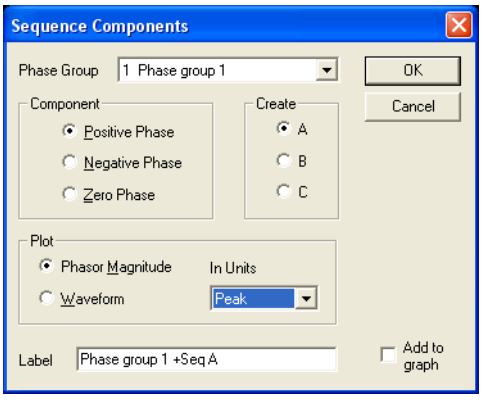

Figure 3.60 Sequence Components

Buttons and Fields

Phase group	Select a phase group whose values are used to compute the sequence components.
Component	Click on Positive phase, Negative phase or Zero phase to select the required component.
Create	Click a radio button to select a phase for the sequence component. The most common is the default value of Phase A.
Plot	Click a radio button for the actual value that is plotted: • *Phasor magnitude* - plots a DC quantity of the sequence component amplitude. • *Waveform* - plots a rotating vector with the same phasor magnitude as the DC plot but with the correct absolute angle.
In Units	Select the units for an amplitude measurement: • *Peak* • *RMS* • *Per Unit* • *Percentage*
Label	DSA creates a label for the new channel as the criteria are specified. Enter a name to alter or replace the provided value. Make the label descriptive of its contents; i.e. *230kV Bus +seq or Line439 Zero Seq*. Enter up to 25 characters but keep the label short for display purposes.
Add to graph	Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Sequence Components Operations

To configure this:

1. Select *Channels* > *Sequence Components* and the dialog appears (Figure 3.61).

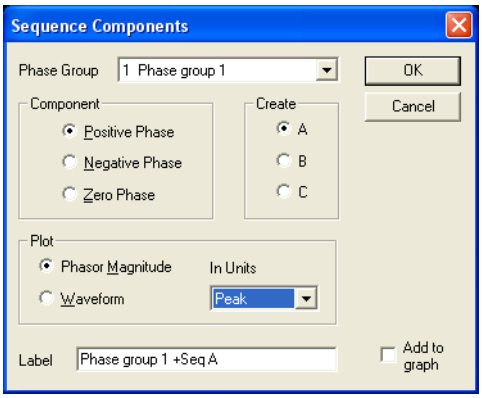

Figure 3.61 Sequence Components

2. Select a *Phase Group*.
3. Click a *Component* radio button:
   - **Positive Phase**
   - **Negative Phase**
   - **Zero Phase**
4. Click a *Create* radio button:
   - **A**
   - **B**
   - **C**
5. Click a Plot radio button
   - **Phasor Magnitude**
   - **Waveform**
6. Select from *In Units*:
   - *Peak*
   - *RMS*
   - *Per Unit*
   - *Percentage*
7. Enter a *Label*.
8. Click **Add to graph**, as required.

9. Click **OK**.

   A confirmation dialog may appear.

10. Click **OK**.

Star/Delta Conversion

Use this window (Figure 3.62) to produce three computed channels by means of a star/delta conversion.

If the specified phase group is in the star form DSA32 defaults to performing a Star»Delta conversion which generates three channels plotting the fundamental phase-to-phase voltages. Conversely, if the group is in delta form, DSA32 defaults to a Delta»Star conversion, generating three channels plotting the fundamental phase-to-neutral voltages.

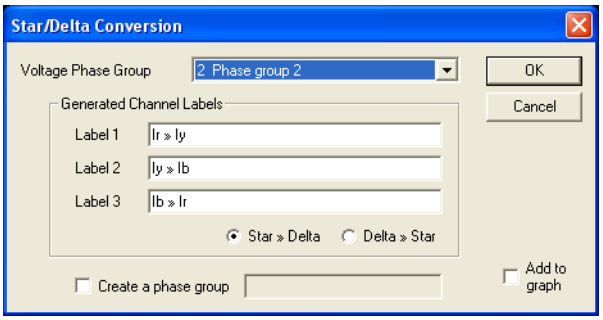

Figure 3.62 Star/Delta Conversion

For non-TR2000, TR100+ or PQR records, the phase group types are defined either the first time the record is loaded into DSA or the first time a calculation requires the phase group classifications. See "Preferences" on page 3-43 for details.

Both conversions are applied to the fundamental phasors extracted from the source channels using the method described in Phasor extraction.

Star to delta

This is accomplished by simply subtracting one phase-neutral phasor from another to obtain the phase-to-phase value:

$$I_{AB} = I_{NB} - I_{NA}$$

where,

I_{AB} The A to B phase to phase vector

I_{NA} The neutral to A phasor

I_{NB} The neutral to B phasor

Delta to star

The three delta form phasors are used first to obtain an assumed neutral point by geometric means. In essence the triangle formed by the vectors is extended into a parallelogram and a point one third of the way along its diagonal is taken as the neutral (Figure 3.63).

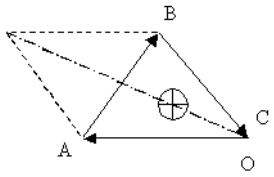

Figure 3.63 Delta to Star Calculation Diagram - Balanced System

In an unbalanced system O and C may not be co-incident and so a more generalized method is required (Figure 3.64).

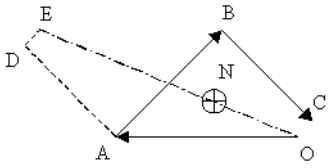

Figure 3.64 Delta to Star Calculation Diagram - Unbalanced System

Vector math is then used to obtain NA, NB and NC. First the neutral point is obtained as follows:

$$
\begin{aligned}
ON &= \frac{1}{3}\left(OA + AD + DE\right) \\
&= \frac{1}{3}\left(OA + \left(OA + AB\right) + OC\right) \\
&= \frac{1}{3}\left(OA + \left(OA + AB\right) + \left(OA + AB + BC\right)\right) \\
&= \frac{1}{3}\left(3OA + 2AB + BC\right) \\
&= OA + \frac{2}{3}AB + \frac{1}{3}BC
\end{aligned}
$$

Building on this result we derive a vector NA, the first of the three phases:

$$
\begin{aligned}
NA &= NO + OA \\
&= OA - ON \\
&= OA - \left(OA + \frac{2}{3}AB + \frac{1}{3}BC\right) \\
&= OA - OA - \frac{2}{3}AB - \frac{1}{3}BC \\
&= -\frac{2}{3}AB - \frac{1}{3}BC
\end{aligned}
$$

Similarly for NB:

$$
\begin{aligned}
NB &= NO + OA + AB \\
&= NA + AB \\
&= -\frac{2}{3}AB - \frac{1}{3}BC + AB \\
&= \frac{1}{3}AB - \frac{1}{3}BC
\end{aligned}
$$

And finally for NC:

$$NC = NB + BC$$
$$= \frac{1}{3}AB - \frac{1}{3}BC + BC$$
$$= \frac{1}{3}AB + \frac{2}{3}BC$$

Buttons and Fields

Voltage phase group

Select the phase group for use as the source for the conversion.

Generated channel labels

DSA32 automatically creates channel labels for the three new channels. These can be long and can be edited if required.

Star >> Delta Delta >> Star

Click the radio button to set the type of translation. Since DSA knows what type the VT is it defaults to the appropriate translation. If the alternative is selected a message appears warning of the possibility of incorrect data being produced.

Create a phase group

Creates a new phase group from the new channels. This is the same operation available from the New Phase Group option and is provided here for convenience. Activate this and an *x* appears. Enter an appropriate name for the new phase group.

Add to graph Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Star/Delta Conversion Operations

To configure this:

1. Select *Channels > Star/Delta Conversion* and the dialog appears (Figure 3.65).

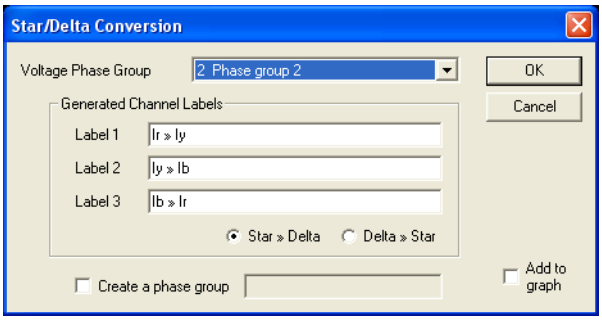

Figure 3.65 Star/Delta Conversion

2. Select a *Voltage Phase Group*.

NOTE

Ensure that it is a voltage phase group.

The Label fields are populated.

3. Edit *Label*, if required.
4. Click either:
   - **Star >> Delta**
   - **Delta >> Star**
5. Click **Create a phase group** and enter a name in the field.
6. Click **Add to graph**, as required.
7. Click **OK**.

   A confirmation dialog may appear.
8. Click **OK**.

Line Group Quantities

Use this window (Figure 3.66) to produce computed channels to be created for power and impedance values.

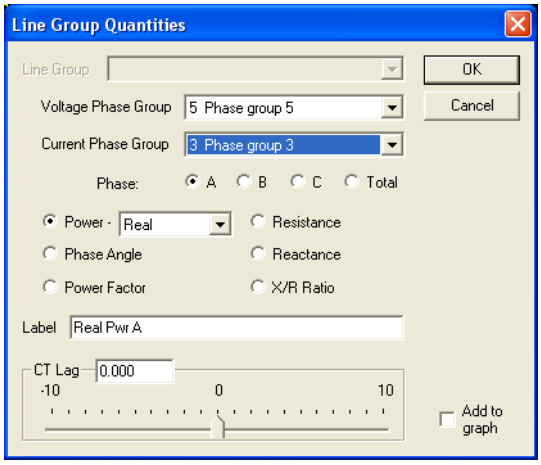

Figure 3.66 Line Group Quantities

The fundamental phasors for the specified voltage and current channels are extracted using the method described in "Single Channel Quantities" on page 3-73.

The phase angle is calculated as the raw angle difference between the two phasors plus the specified correction value for CT lag.

$$\vartheta = \angle V - \angle I + CTLag$$

A number of other quantities are based on this result:

Power factor

$$dPF = \cos(\vartheta)$$

Resistance

$$R = \frac{|V|\cos(\vartheta)}{|I|}$$

Reactance

$$X = \frac{|V|\sin(\vartheta)}{|I|}$$

X/R ratio

$$Ratio = \tan(\vartheta)$$

Buttons and Fields

Line group	Select the line group for use in calculations. When working with non-TR2000, TR100+ or PQR records there are no line groups defined for the record. Use the voltage and current phase groups for the power calculations.
Voltage phase group	Select the voltage phase group for use in calculations.
Current phase group	Select the current phase group for use in calculations. Manual selection of the voltage and current phase groups is only necessary when working with non-TR2000, TR100+ or PQR records for which line groups are unavailable, or when working with user-defined phase groups.
Phase	Click on the button for the phase for use in calculations. For delta wound VTs a delta»star conversion is performed before the parameter is calculated. Selecting Total generates values for the whole line group, only real, reactive and apparent power calculations are available when this option is taken. Total power for a phase-to-phase voltage group is calculated using the two-wattmeter method.

Computed function

Click the radio button for the parameter to use for computing for the length of the record:

- Real power - select from Real, Reactive or Apparent in the drop down.
- Reactive power
- Apparent power
- Phase angle
- Power factor
- Resistance
- Reactance
- X/R ratio

All these quantities are based on the fundamental voltage and current of the selected phase.

Label

DSA creates a label for the new channel as the criteria are specified. Enter a name to alter or replace the provided value. Make the label descriptive of its contents; i.e. *A Watts* or *C pf*. Use up to 25 characters but it is best to keep the label short for display purposes.

CT lag

Include the CT phase error in the calculation. The correction can be up to +/- 10°. It is assumed that the phase error is the same for all three phases.

For TR2000, TR100+ & P&QR records the CT correction defaults to the value defined in the recorder.

Add to graph

Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Line Group Quantities Operations

To configure this:

1. Select *Channels > Group Quantities* and the dialog appears (Figure 3.67).

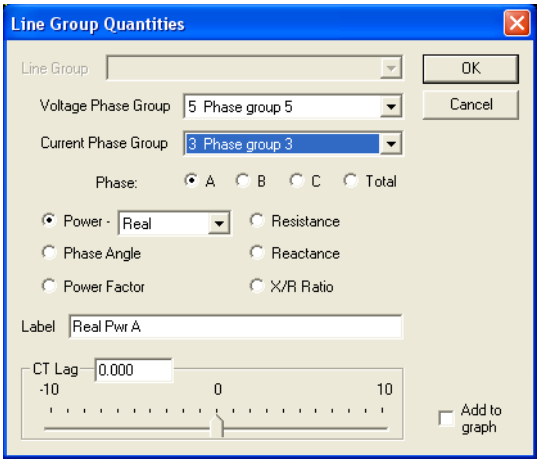

Figure 3.67 Line Group Quantities

2. Select a *Line Group*, if required.

   The fields are populated.

3. Select a *Voltage Phase Group*.

NOTE

Ensure that it is a voltage phase group.

4. Select a *Current Phase Group*.

NOTE

Ensure that it is a current phase group.

5. Click a radio button:
   - **A**
   - **B**
   - **C**
   - **Total**

6. Click a computed function radio button:
   - **Real power** - select from Real, Reactive or Apparent in the drop down.
   - **Reactive power**
   - **Apparent power**
   - **Phase angle**
   - **Power factor**
   - **Resistance**
   - **Reactance**
   - **X/R ratio**
7. Enter a *Label*.
8. Enter a value for *CT Lag* or use the power bar.
9. Click **Add to graph**, as required.
10. Click **OK**.

    A confirmation dialog may appear.
11. Click **OK**.

Phase Group Angles

Use this window (Figure 3.68) to produce computed channels plotting the angles between the individual voltage vectors or current vectors.

Figure 3.68 Phase Group Angles

The new channel contains three traces each plotting the angle of one of the phasors in the selected phase group. The angles are measured relative to one of the phasors - the *reference phasor*, as user-specified. As a consequence, the angle of the reference phasor always reads zero. The other two would, in an ideal system, mark out flat traces at 120° and -120°, respectively.

When the channel is included in a graph with the cursors active, they display angle values for only one of the phasor traces - by default the top one. DSA32 can be set to display the angles of the other two phasors through the "Band Settings" on page 3-7.

Buttons and Fields

Phase group	Select the phase group for use as the source in the computed channel.
Reference Phasor	Specify which member of the selected phase group is the reference phasor for the new channel.
Label	DSA creates a label for the new channel as the criteria are specified. Enter a name to alter or replace the provided value. Make the label descriptive of its contents; i.e. *Vangle* or *Iangle*. Use up to 25 characters but it is best to keep the label short for display purposes.
Add to graph	Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Phase Group Angles Operations

To configure this:

1. Select *Channels* > *Phase Group Angles* and the dialog appears (Figure 3.67).

Figure 3.69 Phase Group Angles

2. Select a *Phase Group*.
3. Select a *Reference Phasor* radio button:
   - **A**
   - **B**
   - **C**
4. Enter a *Label*.
5. Click **Add to graph**, as required.

6. Click **OK**.

   A confirmation dialog may appear.

7. Click **OK**.

Differential Phase Angle

Use this window (Figure 3.70) to produce computed channels plotting the differential phase angles.

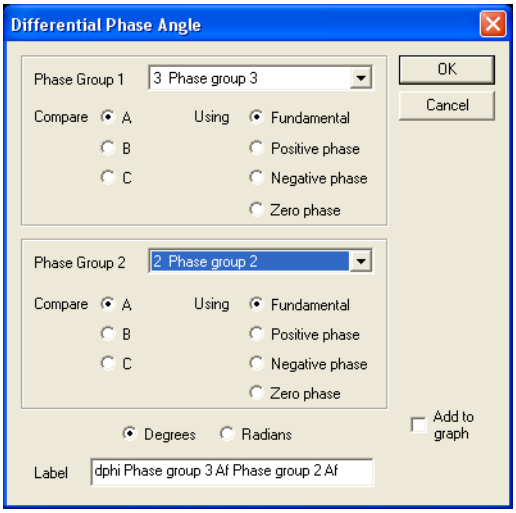

Figure 3.70 Differential Phase Angle

The angles are obtained for the two specified channels either in degrees or radians and the new channel populated with the simple difference between the two.

Buttons and Fields

Phase Group 1	Select the phase group for use in computations.
Compare	Select the phase for use in comparison.
Using	Select the type of comparison: • *Fundamental* • *Positive phase* • *Negative phase* • *Zero phase*
Degrees/Radians	Select the mode of angle measurement.

Label	DSA creates a label for the new channel as the criteria are specified. Enter a name to alter or replace the provided value. Make the label descriptive of its contents. Use up to 25 characters but it is best to keep the label short for display purposes.
Add to graph	Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Differential Phase Angle Operations

To configure this:

1. Select *Channels* > *Differential Phase Angle* and the dialog appears (Figure 3.71).

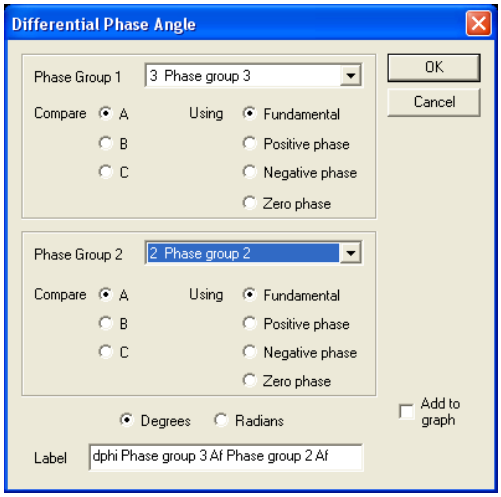

Figure 3.71 Differential Phase Angle

2. Select a phase group for *Phase Group 1.*
3. Click a *Compare* radio button:
   - **A**
   - **B**
   - **C**
4. Click a *Using* radio button:
   - **Fundamental**
   - **Positive phase**
   - **Negative phase**
   - **Zero phase**

5. Repeat step 2, 3 and 4 for Phase Group 2, if required.
6. Click either **Degrees** or **Radians**.
7. Enter a *Label*.
8. Click **Add to graph**, as required.
9. Click **OK**.

   A confirmation dialog may appear.
10. Click **OK**.

New Phase Group

Use this window (Figure 3.72) to add phase groups not specified in the original record.

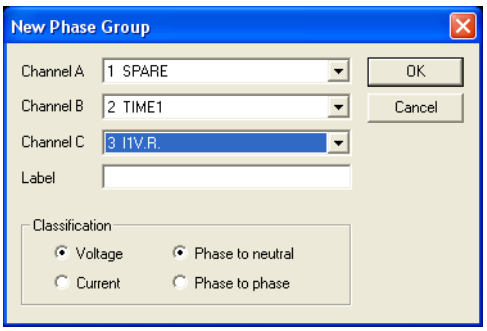

Figure 3.72 New Phase Group

This is valuable where, for example, a CT has been inverted, as a new computed channel can be created that corrects the original. This new channel is then incorporated into a new phase group along with the unimpaired channels. Or, if a phase group has been created incorrectly, a new group is set up in DSA32. New groups created in this way are then used to correctly compute sequence component, power or impedance values.

NOTE

New phase groups created in this way are only available while the record is open, they are not written back to the record file on disk. If you want to restore the user-defined phase group you must save the record layout before closing it. Save it as a record or machine-specific layout and it can be recalled.

To create the phase group, select the three channels that make up. They must all have the same unit (kV or A) and must be in positive sequence order; i.e. R Y B or A B C.

Buttons and Fields

Channel	Select the channel for use in the new phase group.
Label	Enter a name for the new group. Make this descriptive of its contents; i.e. *Gen volts* or *I Tx2*. Use up to 25 characters but it is best to keep the label short for display reasons.
Classification	Select the type of phase group (V or I) and the type of VT (P-N or P-P).
Classification	Click on the radio buttons to select the correct group type.

New Phase Group Operations

To configure this:

1. Select *Channels* > *New Phase Group* and the dialog appears (Figure 3.73).

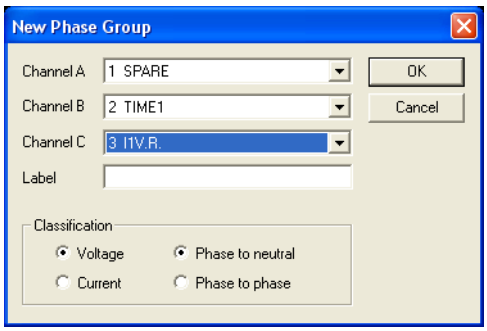

Figure 3.73 New Phase Group

2. Select the appropriate channel(s).

3. Enter a *Label*.

4. Click a *Classification* radio button:

- **Voltage**
- **Current**
- **Phase to neutral**
- **Phase to phase**

5. Click **OK**.

Import Channels

Use this window (Figure 3.74) to import channels.

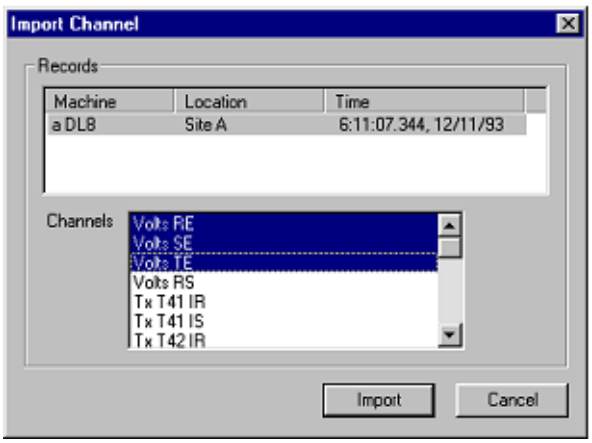

Figure 3.74 Import Channel

A number of records can be opened by DSA at the same time. These normally appear in a number of different graphs. In some circumstances it is desirable to compare signals from different records on the same graph. This is accomplished by importing the channels from one record into another. The imported channels are then available in exactly the same way as the native channels.

The imported channels are included in graphs by selecting Setup or New Graph from the Graph menu. The names of the imported channels are prefixed with *.

The best results are achieved by combining TR2000 records running at the same sample rate. If different sample rates were used, a warning appears about the potential phase error as samples from the imported channel are moved to match them to the nearest sample in the native channel. In such cases, it is better to import the lower rate channel into the record using the higher rate to minimize this alignment error. Attempts to import channels from non-TR2000 records face additional sources of error.

When an import operation is performed, DSA32 does not create a new channel. Both records are now reading data from the source record. As a consequence, if that source record is closed, the imported channel is no longer available and is removed from any open graphs.

Synchronization

When a channel is imported it is automatically synchronized with the native channels. This is done with respect to the time frame of the native record. So, if the source record started 0.002 seconds after the native record, then when its channels are imported no values appear for the first 0.002 seconds of the graph (Figure 3.75). In addition, the last 0.002 seconds of the imported channel are invisible as it runs past the end of the native record.

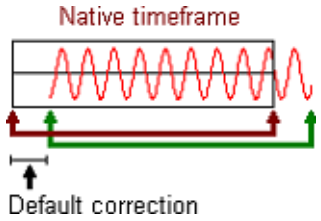

Figure 3.75 Native Time Frame Correction

If there is no period of overlap between the two records, i.e. one started recording only after the other had finished, then the imported channel appears as a flat trace always reading zero.

This synchronization is carried out on the basis of the timestamps written into the records involved. However, it is possible that the clocks in the recorders were incorrectly set when the record was created. In this case, use the Synchronize Imports ("Synchronize Imports" on page 3-97) dialog to calculate and apply the necessary correction.

Buttons and Fields

Records	Lists the records including the Machine name, Location and time of the record creation.
Channels	Lists the channel associated with a record.
Import	Initiates the operation.

Import Channels Operations

To import a channel from another open record:

1. Select *Channels > Import channels.*

   The Import Channel dialog appears (Figure 3.76).

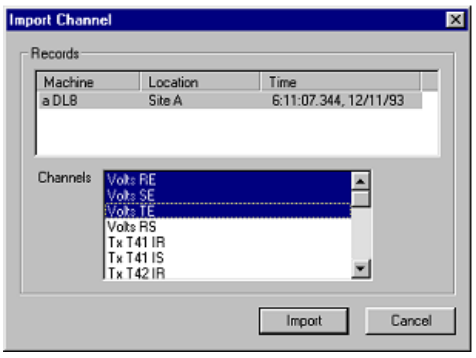

Figure 3.76 Import Channel

2. Select the *Machine name* of the source record.

   The channel names from this record appear in the lower scroll box.

3. Click on one or more channels for importing into the current record and click **Import**.

Synchronize Imports

Use this window (Figure 3.77) to synchronize imports.

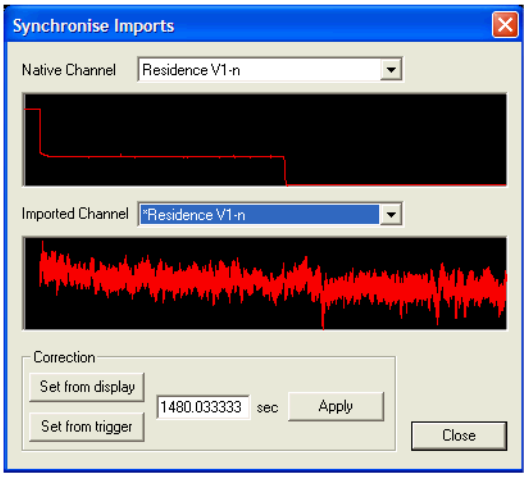

Figure 3.77 Synchronize Imports

When new imported channels have been added to a record they are automatically synchronized with the native channels based on the difference between the times stored in the two records (see "Import Channels" on page 3-95). If these times are not correct, this dialog is used to adjust the relative time to correct for any difference in the absolute times.

The alignment is performed on the basis of a *correction* applied to the imported channel. This correction is the amount subtracted from the imported channel's times (Figure 3.78). For example, the application of a 0.01 second correction causes a sample that would normally appear 0.02 seconds into the record to appear at the 0.01 second point. A negative correction advances the imported signal, so that the point which would otherwise appear 0.02 seconds into the record now occurs at 0.03 seconds.

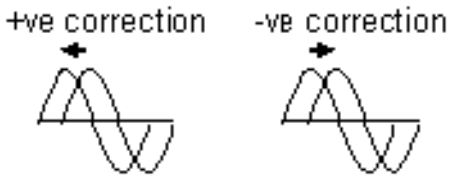

Figure 3.78 Synchronize Correction

DSA32 provides the means to determine the required correction automatically by comparing the imported channel to a native one.

Buttons and Fields

Native Channel	Lists the channels available.
Imported Channel	Lists the channels available for import.
Set from display	Produces a correction in seconds that, if applied to the imported channel, exactly synchronizes the selected points.
Set from trigger	Produces a correction in seconds that, if applied to the imported channel, synchronizes the trigger times in the two records.
Time	Enter a time to use as a correction.
Apply	Applies the correction time.

Synchronize Import Operations

Synchronizing Non-Transient Records

To determine the correction and synchronize non-transient records:

1. Select *Channels > Synchronize Imports*.

The Synchronize Imports dialog appears (Figure 3.79).

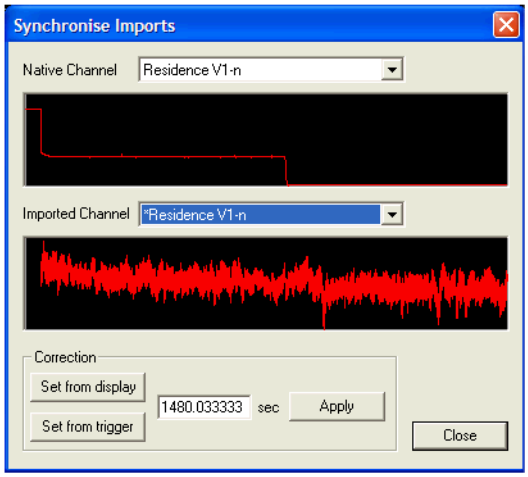

Figure 3.79 Synchronize Imports

2. Select a *Native Channel* from the upper drop down list that is common to the imported channel selected below it.

Both the imported channel and its common native channel appear in the window.

3. Click on the Native Channel and Imported Channel displays and DSA32 seeks out the nearest digital transition or zero crossing (rarely available). These points are marked out with a white line in each display.

4. Select digital transitions, manually enter a time adjustment, or select zero-crossings, if available, on both signals that represent the same moment in time.

5. Click **Set from display**.

6. Enter a time.

7. Click **Apply** to offset the imported channel.

Synchronizing Transient Records

With transient records in particular, a relatively small error in record times can lead to the situation where there is no period of overlap at all between the records. Consequently, the imported channel is not visible and it is not possible to use the procedure outlined above to determine the required correction.

In such cases:

1. Select *Channels > Synchronize Imports*.

   The Synchronize Imports dialog appears (Figure 3.79).

2. Select a *Native Channel* from the upper drop down list that is common to the imported channel you select below it.

   Both the imported channel and its common native channel appear in the dialog. If the records do not overlap, a flat trace appears. The next steps synchronize the trigger time so the trace appears.

3. Click on the displays and DSA32 seeks out the nearest zero crossing or digital transition. These points are marked out with a white line in each display after manually selecting the point for TBD.

4. Select zero-crossings or digital transitions on both signals that represent the same moment in time.

5. Enter a time, if desired or use the *set* from trigger display selections.

6. Click **Set from trigger**.

   Sometimes this is sufficient to effect full synchronization but even if it is not, it is guaranteed to leave the imported channel visible so that the conventional means of synchronization, via a common digital transition for example, are available.

7. Click **Apply** to offset the imported channel.

Long Term Flicker (Plt)

This calculation is only valid for data from a flicker logger.

Buttons and Fields

Pst Channel	Used as basis for the production of the long term flicker data.
Label	Populated with a default label based on the Pst Channel selected which can be altered, as required.

Window Width	Used as the time period over which the long term flicker calculation is performed. The value represents the number of 10 minute Pst values to use. The default value of 12 dictates that the long term flicker is calculated over a period of 2 hours.
Add to graph	Check this box to add the new channel immediately. For more information see "Add to graph" on page 3-67.

Long Term Flicker Operations

To produce a long term flicker (Plt) calculated channel from a Pst channel:

1. Select *Channels > Long Term Flicker*.

   The Long Term Flicker (Plt) dialog appears (Figure 3.80).

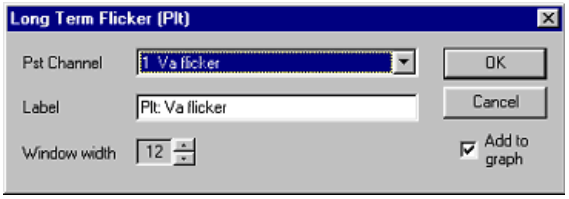

Figure 3.80 Long Term Flicker (Plt)

2. Select the *PST Channel,* enter a Label and select a *Window widt*h for the new channel.
3. Click **OK**.
4. Click **Add to graph**, as required.
5. Click **OK**.

   A confirmation dialog may appear.
6. Click **OK**.

NOTE

See Appendix A "Expert System" for details on operation of DTF and ES32.

Tools Menu

There is an option within DSA32 where extra analysis modules can be added. At present there are two options available. These are:

- Distance to fault calculation (transient records)
- Expert System fault classifier (transient & disturbance records)

NOTE

If neither of the optional modules has been installed, the Tools menu does not appear.

Options Menu

This menu consists of:

- ″Show Analog Labels″
- ″Show Digital Labels″
- ″Show Phasors″
- ″Show Annotations″
- ″Time Axis″
- ″Cursors″ on page 3-104
- ″Add Annotation″ on page 3-105

Show Analog Labels

Switches on/off analog channel labels to maximize the amount of screen for the waveforms.

To do this:

- Select *Options > Show Analog Labels*.

  If the names are not shown the channel numbers from the record appear.

Show Digital Labels

Switches on/off digital channel labels to maximize the amount of screen for the waveforms.

To do this:

- Select *Options > Show Digital Labels*.

  If the names are not shown the channel numbers from the record appear.

Show Phasors

Toggles on/off the phasors on/off on the screen.

To do this:

- Select *Options > Show Phasors*.

Show Annotations

Toggles on/off the annotations on/off on the screen.

To do this:

- Select *Options* > *Show Annotations*.

Time Axis

Zoom

When a graph is first displayed the whole record appears. To expand a section in the active graph either:

- Select *Options* > *Time axis* > *Zoom* or click  .

  The mouse pointer changes to a magnifying glass symbol. While it appears in this form its movements are restricted to the signal area of the active graph making it easy to select the start or end of the display.

To select the display start and end:

1. Move the center of the icon to the start of the region of interest and press and hold the left mouse button.
2. Drag the mouse to the end of the region and release the button.

   The area selected is highlighted and the selected section expands to fill the screen width when the mouse button is released. Alternatively, if you have a mouse wheel you can use it to zoom ("Mouse Wheel Support" on page 3-12).
3. Repeat this several times. If there are only a few data points in the area for expansion a *Zoom too strong* error message appears. If one or more of the PAT dialogs is active and less than a cycle of data is visible after the zoom, DSA32 issue a warning since PAT's calculations assume that an integral number of cycles are enclosed by the cursors.

Unzoom

To return the display to the original size:

- Select *Options* > *Time axis* > *Unzoom* or click  .

NOTE

Even if several distinct zoom operations were performed, a single Unzoom will undo them all. The mouse wheel can also be used to unzoom the display.

Cursors

The cursors appear as two vertical lines drawn over the signals in the graph. Beside and below each analog channel name or number the instantaneous values at the cursor positions appear followed by the difference and units. For logger channels the cursor value is for the maximum, average or minimum waveform. The default is the average.

The default setting shows the instantaneous values at the cursor points. Alternatively, the RMS value of the cycle following the cursor position can be displayed ("Right Click Menu" on page 3-14). The display changes and *RMS* appears on the display.

For logger records the maximum and minimum values of the visible data appear to the right of the graph. This is the maximum value of the maximum channel and the minimum of the minimum channel and are the values used if the auto scaling option is chosen. Changing the scale of the channel does not alter these values.

For the digital channels, the status at each cursor is shown as a thin green line for the normal state or a thick red line for the alarm state.

The times relative to the trigger point appear above the graph (T1 & T2) with the differential time (TD) and the time units.

If the waveforms have been greatly magnified the cursors are seen to jump from data point to data point.

If one or more of the PAT dialogs is active, the cursor positions are adjusted after every movement to ensure that an integral number of cycles are enclosed between them. If the graph is zoomed to display less than a cycle's worth, a warning appears and the cursors are fixed at the left and right edges of the display.

The cursors must be active for the phasor display to be made available.

Cursor Operations

To toggle the dual cursors in the active graph cursors on/off:

- Select *Options* > *Cursors* or click  .

To move the left cursor:

- Click and hold the left mouse button and drag it to the new position.

To move the right cursor:

- Click and hold the right mouse button and drag it to the new position.

For fine control of both cursors:

- Use the left and right arrow keys to move the cursors simultaneously.

For independent cursor control:

- Use <Ctrl>+arrow keys to move the left cursor and <Shift>+arrow keys to move the right cursor.

Add Annotation

DSA provides the capability for text notes that are associated with a particular point in a specified channel for any supported record type (Figure 3.81). Such annotations are drawn directly on the graph display in a box with a line indicating the point with which it is associated. They are also included in printed graphs.

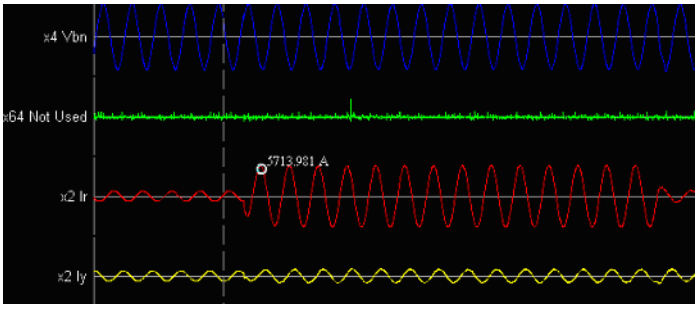

Figure 3.81 Annotation Example

Once created, annotations are stored alongside the record and appear when the record opens. Annotations are associated with the actual data in the channel and not just with a particular graph window. Thus, if an annotation is created on a channel that appears in more than one graph window the annotation appears on all the graphs where that channel is found.

Annotations are drawn in one of two ways: opaque or transparent:

- Transparent annotations are drawn so that the graph details underneath the text are still visible.
- Opaque annotations erase the portion of the screen immediately under the text so that it is more easily read. The mode in use is set application wide in the "Preferences" on page 3-43.

Positioning

By default, annotations on the left hand side of a graph are drawn to the right of the sample they are associated with. If this point is moved to the right hand side of the graph, the annotation is drawn on the left. This is done so that the text is visible on screen at all times while the annotated sample is displayed.

If the automatically assigned position is inconvenient, overlaps other annotations or obscures signal detail, than reposition it. Once an annotation has been manually positioned in this way it maintains the same horizontal and vertical offset from the annotated sample.

Details of manual positioning are not stored along with the record data but they can be saved in per-record layouts.

An annotation can be manually positioned and it maintains the same horizontal and vertical offset from the annotated sample. As a consequence it is possible to horizontally scroll a zoomed graph so that the annotation is off-screen while the sample it is associated with is still visible.

Modifying Annotations: Right-Click Menu

Modify annotations by double-clicking on the text and the Annotation dialog appears.

It is also possible to display an annotation context menu by right clicking on the text of the annotation. The options on this menu are:

Edit	Opens the Annotation dialog.
Move	Returns to the sample selection mode used when creating the annotation. A new sample can be chosen to with which associate the annotation. As well as moving the annotation to another sample in its channel, the annotation can also be placed on an entirely different channel.
Delete	Removes the annotation.
Add new	Opens the Annotation dialog.
Auto-position	Appears when the annotation has been manually positioned. Selecting this returns the position of the annotation to the application-controlled positioning method.

Annotations
Operations

To add an annotation on the active graph:

1. Click either:
   - Select *Options* > *Add Annotation*.
   - Click  .
   - Select *Add Annotation* from the right-click menu displayed by right-clicking on an existing annotation.

   The cursor is confined to the data area of the active graph and, as the mouse is moved, the current point in the channel is highlighted with its value at that point displayed alongside. For a multi-channel band or logger record the annotation attaches to the first or active channel.
2. Click on the left mouse button to select the currently highlighted point as the location for the new annotation.

   The Annotation dialog appears (Figure 3.82).

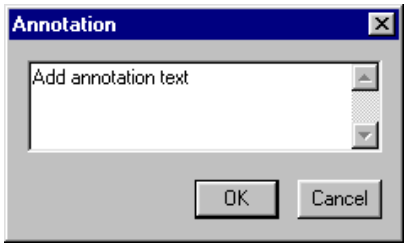

Figure 3.82 Annotation

3. Enter the annotation text of the annotation.
4. Click **OK** to save the annotation.

Suppress Annotations

To suppress the display of annotations:

- Select *Options* > *Show Annotations*. This only affects the current display and does not delete the annotations.

Repositioning and annotation

To reposition:

- Click on the text and drag the mouse cursor and reposition the annotation.

Windows Menu

This menu consists of:

- "Cascade Windows"
- "Tile Horizontally" on page 3-108
- "Tile Vertically" on page 3-108
- "Arrange Icons" on page 3-108
- "Save Layout" on page 3-109
- "Delete Layout" on page 3-113
- "Close" on page 3-22
- "Close All" on page 3-114
- "Close All but Current" on page 3-114

Cascade Windows

To cascade windows:

- Select *Windows > Cascade* and all the graph windows overlap so that each title bar is visible.

Tile Horizontally

To tile windows vertically:

- Select *Windows > Tile Horizontally* to arrange the open graphs in smaller sizes to fit next to each other in the main DSA32 window.

The windows are arranged with each window taking as much of the horizontal screen-space as is possible.

Tile Vertically

To tile windows vertically:

- Select *Windows > Tile Horizontally* to arrange the open graphs in smaller sizes to fit next to each other in the main DSA32 window.

The windows are arranged with each window taking as much of the vertical screen-space as is possible.

Arrange Icons

To arrange icons:

- Select *Windows > Arrange Icons* to arrange a number of minimized graph windows evenly along the bottom of the main DSA32 window.

Save Layout

Use this window (Figure 3.83) to save the layout.

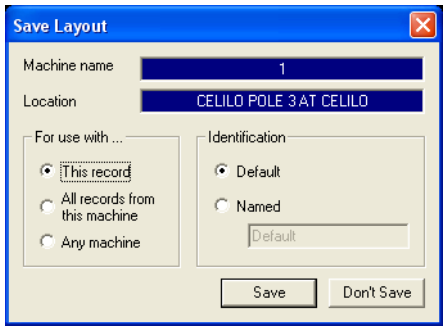

Figure 3.83 Save Layout

The layout of a record comprises the visual appearance and configuration of all graph windows open on that record. For each graph the following details are included:

- Window size and position
- Graph title
- Current zoom applied to the graph
- Cursor status (on or off) and, if they are on, the cursor positions
- Phasor display status (on or off)
- Phasor display configuration
- Phasor display title
- Phasor display cursor association (left or right)
- Included phase groups
- Phase group display properties (fundamental, positive phase sequence etc.)
- Phasor display annotation
- The bands defined in the graph
- Band label
- Band gain
- Band's active channel
- Computed channels
- User-defined phase groups

Since the layout details apply only to a single record the importing of channels is not recorded and such imports is not restored when a saved layout is used.

Saving these details means that having set up a useful display of a record, including perhaps the creation of several computed channels, it is possible to save that display and restore it later to continue analysis. In addition, it is possible to associate a saved layout with a particular recorder that can then be used with any record retrieved from that machine.

If a layout is saved for any record from a selected recorder the channel scaling reverts to the default autoscale option. This is to ensure that waveforms are not cropped for different fault types; i.e. high levels of fault current.

Buttons and Fields

Machine name	Displays the Machine name for informational purposes.
Location	Displays the location of the recorder that produced the record.
For use with	Under that two sets of radio buttons control how the layout is saved.
For use with	Click an option: *This record* - associates the layout exclusively with the current record. It is only available when working with this record. All records from this machine - associates the layout with the recorder so that it is made available with any record generated by the same machine. Any machine - associates the layout with any record from any machine. If the number of channels in the record is larger than the layout, undefined channels are given default settings.

Identification Click an option:

- Default - Gives the layout the name Default. Save subsequent layouts by selecting a Named layout and entering a unique name for the layout. If a layout with the same name already exists it is replaced. No warning is given if a layout is overwritten.
- *Named* - Enable saving more than one layout against a record or a machine. They are distinguished by an identifying name.

Save Layout Operations

To save the layout of the active record:

1. Select *Windows > Save Layout*.

Figure 3.84 Save Layout

2. Click a *For use with* radio button:

- **This record**
- **All records from this machine**
- **Any machine**

3. Click a *Identification* radio button:

- **Default**
- **Normal - enter a name in the field.**

4. Click **Save** to confirm the save operation.

   If the Always save option is selected in Preferences then the Save Layout dialog appears as each record is closed in DSA32. When DSA32 itself is shut down, the dialog also appears once for each record open at that time.

NOTE

A layout includes any tiles from the record or machine that may not have been visible when the layout is saved.

Restoring a layout

Once a layout has been saved DSA32 offers to restore it whenever a suitable record is opened (Figure 3.85). How this is done depends on the choices made in "Preferences" on page 3-43.

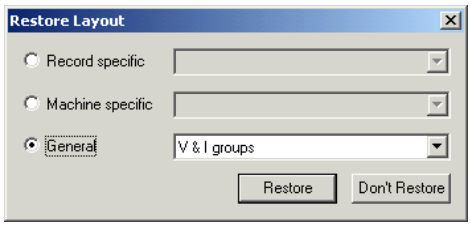

Figure 3.85 Restore Layout

The normal behavior is as follows:

- DSA32 checks the record being opened to see if there are any per-record or per-machine layouts available for it.
- If there are then the Restore Layout appears with the details of all available layouts.
- A radio button provides a choice between Record specific or Machine specific layouts - these choices answer to the For use with selection made when the layout was saved. For each choice a drop down list of the layouts is available. If a default layout is available it appears first followed by any named layouts.

Restore Layout Operations

The Restore Layout dialog appears (Figure 3.85).

Click a radio button and select a suitable layout from the associated drop down.

Click either:

- **Restore** to recreate the graph windows.

  or

- **Don't Restore** or hit <Escape> to bypass the layouts and simply produce graphs following the standard configuration.

Delete Layout

This dialog (Figure 3.86) deletes a saved layout.

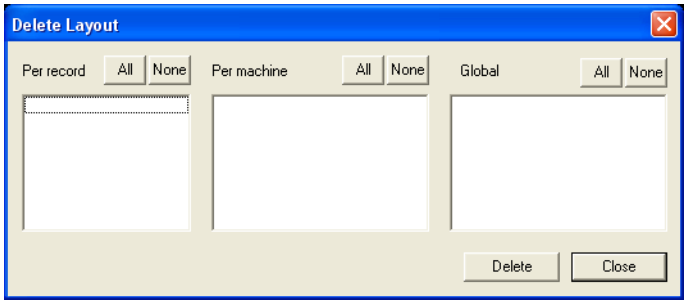

Figure 3.86 Delete Layout

Standard layout

If DSA32 is allowed to set up the window with its standard layout it creates one band for each channel. Up to eight analog channels and sixteen digitals are added to each graph window. Digitals and analogs are always interleaved by displaying up to two digitals between each pair of analog bands. If there are more channels in the record than fit in this default allocation DSA32 continues to create new windows until all channels appear.

As each band is created an optimal scale is applied to it. This is determined by finding the maximum scaling factor that keeps the whole signal visible. Members of each of the various phase groups are initialized with the same scale.

New windows can be created and the layout of existing windows can be altered using the Graph Setup dialog. Each band also has a number of display options that are configured through the "Band Settings" on page 3-7.

Buttons and Fields

Lists — Contains three lists, one for each type of record layout: per-record, per-machine and global. Each is filled in with the existing layouts of each type.

All	Selects all of the entries in the associated list.
None	Deselects all items in the associated list.

Delete Layout Operations

To delete a previously saved layout:

1. Select *Windows > Delete Layout.*

   The Delete Layout dialog appears (Figure 3.87).

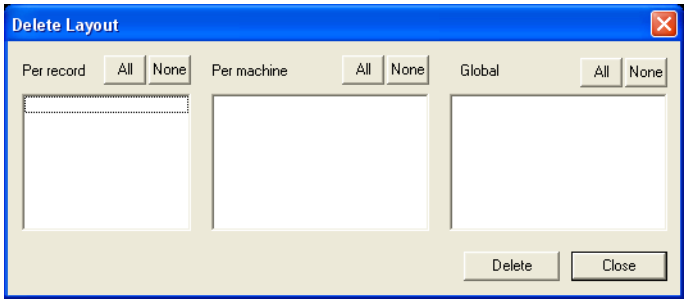

Figure 3.87 Delete Layout

2. Select one or more layouts from any of the lists and click **Delete** to erase the stored details.

Close All

This closes all open records.

To perform this operation:

- Select *Window > Close All.*

Close All but Current

This closes all the open records simultaneously except the active record.

To perform this operation:

- Select *Window > Close All but Current.*

Help Menu

The Help menu consists of:

- "Help Topics"
- "About DSA32"

Help Topics

The information in the application Help is mostly duplicated in this manual.

To open help:

- Select *Help > Help Topics* and the main contents page for the DSA32 help system appears.

About DSA32

This dialog (Figure 3.88) contains copyright and licensing information for the product together with its version number. Under the Components heading it lists details of a number of system components utilized by DSA32. When seeking support you may be asked to provide some of the information found here.

To display this dialog:

- Select *Help > About Display Station Analysis* and the dialog appears (Figure 3.88).

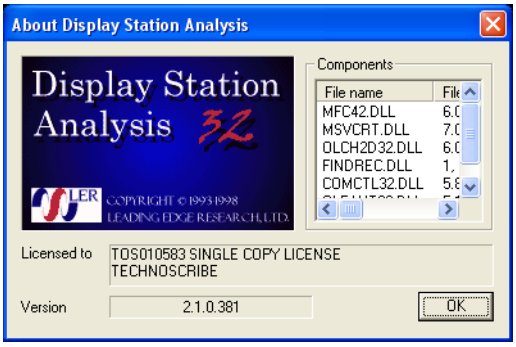

Figure 3.88 About Display Station Analysis

System Information

Table 3.1 list the system capabilities.

Table 3.3 System Capabilities

Item	Capability
Maximum record size	2 Gbyte
Maximum number of samples per record	2,147,483,648
Maximum number of channels per record	2,147,483,648
Maximum number of records open simultaneously	30
Maximum number of windows open simultaneously	Unlimited
Maximum number of channel colors in a COL file	~1500
Maximum number of installed Tools	9
Minimum point size for scaling text	2.5

NOTE

These are theoretical limits. The physical capabilities of the machine or of Windows may prevent some of them from being approached in actual use.

Appendix A. Expert System

Expert System Overview

This appendix explains the operations of the Expert System and the DS32 subcomponents that rely on it for operation:

- Distance to Fault,
- Breaker Performance Monitor, and
- Voltage Dips Analysis.

Figure A.1 shows how the Expert System relates to the optional DSA 32 components.

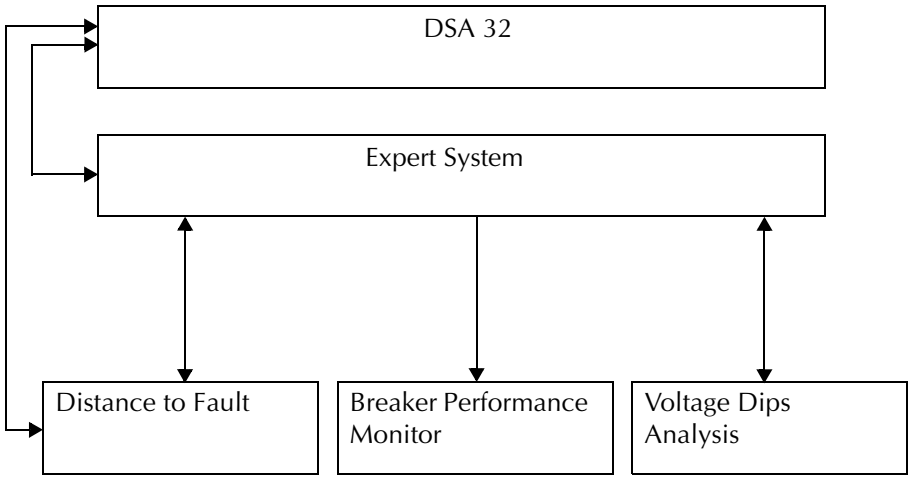

Figure A.1 Expert System Reliant Components

Expert System Introduction

This application is an Expert System fault classifier, opened from the Display Station Analysis Tools menu, or set up to run automatically using the appropriate Display Station options in Autopoll mode.

Figure A.2 shows the Expert System main window.

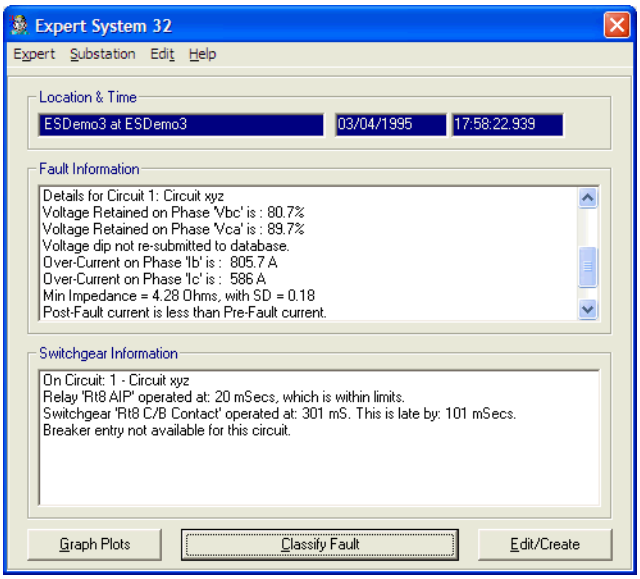

Figure A.2 Expert System Main Window

Its purpose is to take the fault record being analyzed in Display Station and presenting fault record information, such as the type of fault, and whether the switchgear has operated within the correct times. It also has a graphing function for viewing the fault currents and voltages in RMS form.

Expert System Operation - Background

Run the Expert System from the DSA Tools menu and the Expert System uses the location information stored in the current record file to locate a Substation Configuration file. This file contains data about how the recorder is connected to the substation, how many out going feeders it has and information about the protection relays and switchgear. There are also values that are used to *fine tune* the system. This file is currently optimized for distribution substations.

When the fault classifier loads, it attempts to locate the Substation Configuration File. If this file is not found, a message appears along with the Main Window. You must click Edit/Create to display the Substation Details window.

The Expert System then converts all the selected voltage and current channel data to RMS format. This information is displayed using the Graph Plots option and makes searching for variations much easier. All changes in voltage and current levels and digital transitions are measured and sent for record classification.

The classifier looks for fault current on the phase and neutral current inputs and voltage dips on the phase voltage inputs. There are a number of basic classification categories:

- Single phase fault
- Multi-phase fault
- High impedance fault
- Voltage dip (upstream fault)
- Switchgear closure
- No detectable event

The classifier reports its findings with a list of the basic measurements. These include the fault current levels, voltage depression, relay and switchgear operating times.

If available and selected, information from the operation of local switchgear is exported to BPM, which determines when maintenance is due. This is based on three selectable schemes. See "BPM Menus and Windows" on page A-61.

Voltage dip information is also exported to another Voltage Dips Analysis, which classifies dips by depression and duration. Over time this gives a picture of power quality delivered to customers. See "Voltage Dips Windows and Menus" on page A-44.

When run in automatic mode under Autopoll, the classification information for each record is added to the record file for Display Station viewing. The classification data for all the records transferred under Autopoll is also appended to a text file called *AUTOPOLL.OUT* in the *C:\DS* directory. This file can be read by a standard text editor, such as Notepad or Write. To prevent the file from getting too large, delete or copy the data to another file after it is read.

RMS Graphs Window

The RMS Graphs main window is made up of three parts:

- A menu and toolbar at the top,
- An icon bar to access operations (Table A.1), and
- A status bar at the bottom - displays minimum and maximum values for the graph type and for the active cursor, graph values for that point on the graph.

Table A.1 RMS Graphs Main Toolbar Icons

Icon	Function
	New RMS graph (”RMS Graphs Window” on page A-4)
	RMS Graph setup (”Graph Plots” on page A-15)
	Unzoom the active graph (”Unzoom” on page A-10)
	Toggle Y-Axis origin (”Toggle Origin” on page A-10)
	Toggle Y-axis as % (”Toggle % Nominal” on page A-10)
	Copy the active graph to clipboard (”Edit Copy” on page A-10)
	Save RMS Graph to File (”Save Graph” on page A-10)
	Tile Window Horizontally (”Window Menu” on page A-10)
	Tile Window Vertically (”Window Menu” on page A-10)
	Cascade Windows (”Window Menu” on page A-10)

Table A.1 RMS Graphs Main Toolbar Icons (Continued)

Icon	Function
	Print the active graph ("Print/Print Preview/Print Setup" on page A-10)
	Print preview for the active graph ("Print/Print Preview/Print Setup" on page A-10)
	Help Contents ("Help Menu" on page A-10)
	Exit

The color of each line is representative of the phase. For example:

- RMS Phase A = Red
- RMS Phase B = Yellow
- RMS Phase C = Blue
- Neutral = Green

The X-axis shows the time in milliseconds for RMS waveforms. This time runs for the duration of the fault. Negative time is pre-fault time and positive time is post fault time.

The Y-axis represents either Current or Voltage for the RMS waveform. The scale is labeled beside the Y-axis. This is *A* for Amps, *V* for Volts, or *kV* for Kilovolts, etc. The default origin always represents zero current or voltage.

RMS Graphs Right-Click Menu

The right click menu consists of items from the Graph menu. See "RMS Graph Menus" on page A-6.

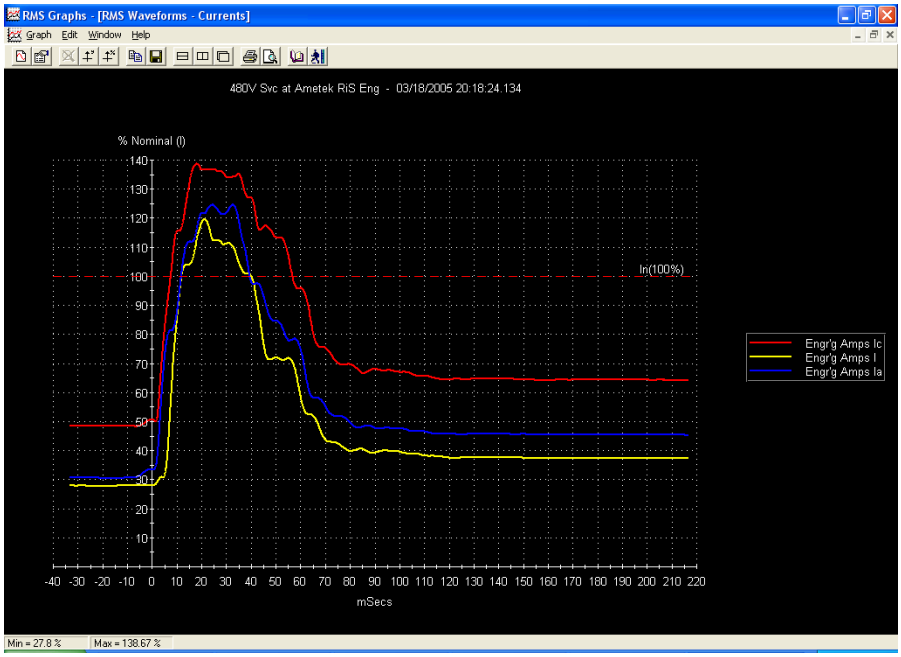

Figure A.3 RMS Graph Plot

RMS Graph Menus

The menus consist of:

Graph Menu

The Graph menu consists:

- "New Graph"
- "Setup Graph" on page A-7
- "Save Graph" on page A-10
- "Toggle % Nominal" on page A-10
- "Toggle Origin" on page A-10
- "Unzoom" on page A-10
- "Print/Print Preview/Print Setup" on page A-10
- "Edit Copy" on page A-10
- "Window Menu" on page A-10
- "Help Menu" on page A-10

New Graph

See "Graph Plots" on page A-15.

Setup Graph

Use this window (Figure A.4) to configure:

- Graph appearance issues
- Automatic creation issues
- Target Platform Resolution
- Graph Footer Text

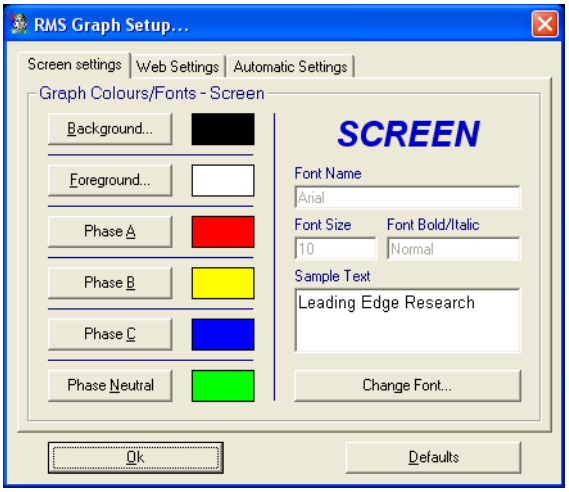

Figure A.4 RMS Graph Setup - Screen Settings

Buttons and Fields

These items are the same for the Web Settings tab.

Graph Colours/Fonts - Screen

Click a button and use the popup to configure the color for that item. Configurable items include:

- *Background*
- *Foreground*
- *Phase A, B, C* and *Neutral*

Sample Text — Displays sample text based on the Change Font selection.

Change Font — Opens a standard Windows font selection window.

Figure A.5 shows the Automatic Settings tab.

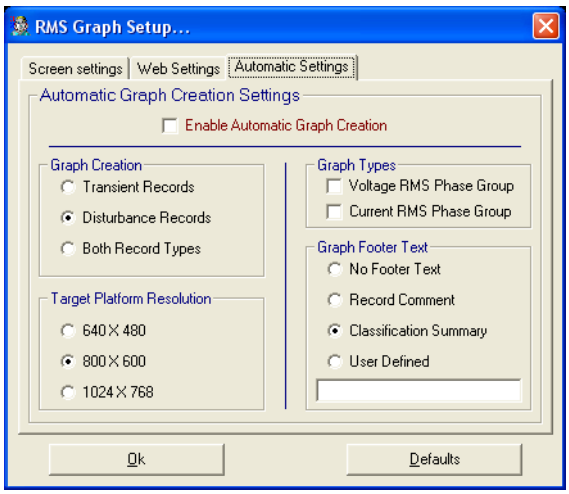

Figure A.5 RMS Graph Setup - Automatic Settings

Buttons and Fields

Enable Automatic Graph Creation

Activate to enable automatic graph creation and activate the inputs in the Graph Creation and Graph Types areas.

Graph Creation Enable the types of graphs to auto-create:

- *Transient Records*
- *Disturbance Records*
- *Both Record Types*

Graph Types Enable the types of channels to auto-create:

- *Voltage RMS Phase Group*
- *Current RMS Phase Group*

Target Platform Resolution

Enable the target resolution:

- *640 X 480*
- *800 X 600*
- *1024 X 768*

Graph Footer Text Dictate the graph footer text:

- *No Footer Text*
- *Record Comment*
- *Classification Summary*
- *User Defined* - enter the text in the field

Setup Graph Operations

To configure graph settings:

1. Select *Graph > Setup Graph*.
2. Configure the *Screen Settings* and *Web Settings* tabs by:
   a. Click a button and the Color dialog appears.
   b. Click on a new color and click **OK**.

NOTE

See "Color Configuration Operations" on page 3-35 to define custom colors.

3. Click **Change Font**, use the dialog to select font choices and click **Close**.
4. Configure the *Web Settings* tab by:
   a. Click **Enable Automatic Graph Creation**, if required.
   b. Click a *Graph Creation* radio button, if required:
      - **Transient Records**
      - **Disturbance Records**
      - **Both Record Types**
   c. Click a *Graph Types* radio button, if required:
      - **Voltage RMS Phase Group**
      - **Current RMS Phase Group**
   d. Click a *Target Resolution* radio button, if required:
      - **640 X 480**
      - **800 X 600**
      - **1024 X 768**
   e. Click *Graph Footer Text*, if required:
      - **No Footer Text**
      - **Record Comment**
      - **Classification Summary**
      - **User Defined** - enter the text in the field.
5. Click **OK**.

Save Graph

Use this option to save the graph as a .bmp or .wmf file.

Save Graph Operations

To save the graph:

1. Click *Graph > Save Graph* and a standard Save As dialog appears.

2. Navigate to a directory, enter a name and click **Save**.

Toggle % Nominal

Use this option to enable/disable the % Nominal axis.

Toggle % Nominal Operations

To enable/disable:

- Click *Graph > Toggle % Nominal* and the axis is toggled.

Toggle Origin

Use this option to enable/disable the origin. Enabled and zero becomes origin for the graph.

Toggle Origin Operations

To enable/disable:

- Click *Graph > Toggle Origin* and the origin is toggled.

Unzoom

Use this option unzoom a graph.

Unzoom Operations

To unzoom:

- Click *Graph > Unzoom* and the graph is unzoomed.

Print/Print Preview/Print Setup

See "Print/Print Preview/Print Setup" on page 3-37.

Edit Copy

See "Copy" on page 3-39.

Window Menu

See "Windows Menu" on page 3-108.

Help Menu

See "Help Menu" on page A-35.

Distance to Fault Introduction

Distance to fault (DTF32) (Figure A.1) is an optional analysis module for Display Station 32.

To start DTF:

- Select *Tools > Distance to Fault 32*. It is also run automatically during the Expert System (ES) classification. The Expert System application must be available for DTF32 to operate.

The DTF algorithm is based on the well tried and tested single ended impedance model approach first promoted by Takagi in 1982. Improvements made by Ericson in 1985 have been included.

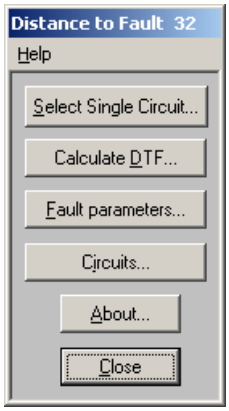

Figure A.6 Distance to Fault 32 Menu Dialog

Before a calculation can be made, the line impedance values (Zl) and line length (L) must be entered. For parallel lines, a mutual coupling value can also be entered. To compensate for remote end power in-feed into the fault, enter an estimate for the remote end impedance (Zb). A local source impedance (Za) can also be entered, if it is available. The line impedances can be entered in either sequence component or phase component form (Figure A.7).

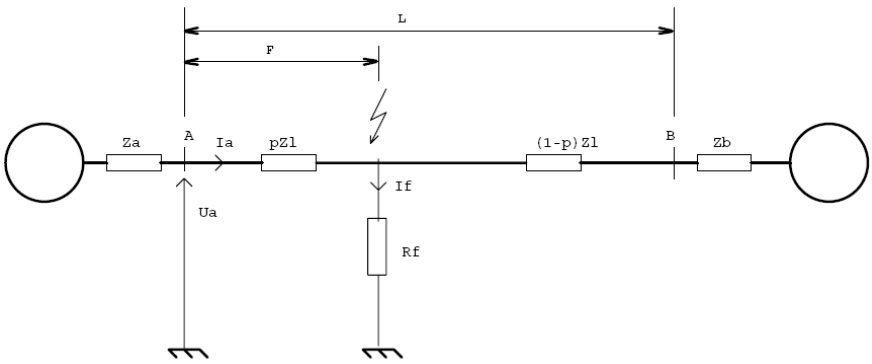

Figure A.7 Line Impedance

The DTF algorithm measures the pre-fault and fault currents to compensate for remote end in-feed. The fault distance is computed several times during the fault period, and the results averaged.

Breaker Performance Monitor Introduction

The Breaker Performance Monitor (BPM) records the operations of switchgear recorded by the Ametek transient fault recorder and interpreted by the Expert System. The database is used to monitor which breakers are due for servicing due to cumulative or accumulated contact wear worked out using a settable wear formulae.

NOTE

The Expert System software must be installed for circuit breaker data to be exported to the BPM application.

Each fault record is analyzed and specific parameters on the operation of local switchgear are extracted. These are exported to an external database and recording over time the performance of the circuit breakers are analyzed. The accumulated number of operations, arcing current and arcing time all contribute to wear of the main contacts. By selecting one of the three standard formulae the service period for each piece of switchgear are determined.

The operate times of the protection relay and circuit breaker are also recorded.

Volt Dips Analysis Introduction

The Voltage Dips application records and displays voltage events in the form of dips and surges recorded by the transient fault recorder and interpreted by the Expert System.

NOTE

The Expert system software must be running for data to be automatically exported to the dips database.

By accumulating data over time a profile of the power quality in terms of voltage variation is generated. This profile is used to compare variations in quality at the same site or check voltage variations across many locations.

The data stored in the database can be displayed graphically in one of two ways:

- A 3D bar chart which graphs dip level against duration against the number of events.
- A scatter plot where each event is located on a 2D graph by dip and duration. Standard limit curves are also shown for comparison.

The records in the database are stored in the Microsoft Access© format (.mdb), and they can also be viewed if necessary by Access©, Excel© or any other application which can read .mdb files.

Menus and Widows

This section explains the menu items that appear for each of the subcomponents. See:

- ″Expert System Menus″
- ″Distance to Fault Menus and Windows″ on page A-37
- ″Voltage Dips Windows and Menus″ on page A-44
- ″BPM Menus and Windows″ on page A-61

Expert System Menus

Figure A.8 shows the Expert System main window.

Access this window by:

- Clicking **Expert System** from a Record dialog in DS.
- Selecting *Tools > Expert System* 32 in DSA.

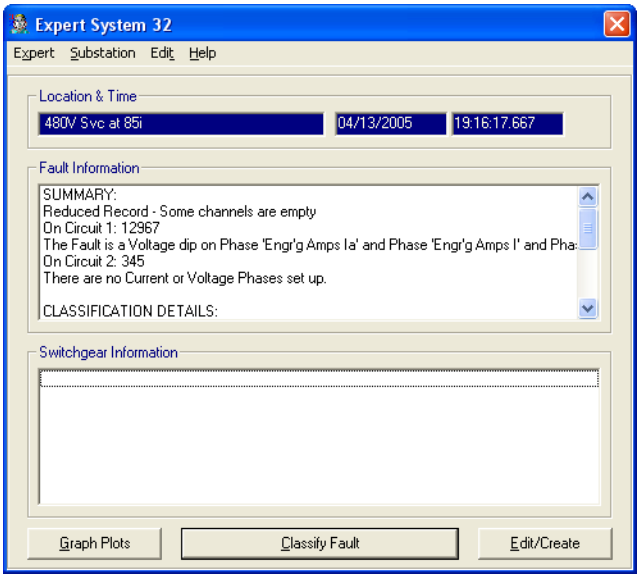

Figure A.8 Expert System Main Window

For information on:

- Graph Plots see ″Graph Plots″ on page A-15.
- Classify Fault see ″Classify Fault″ on page A-17.
- Edit Create see ″Substation Menu″ on page A-19.

This menu consists of:

- ″Graph Plots″
- ″Classify Fault″ on page A-17
- ″Export Switchgear″ on page A-18
- ″Export Dips″ on page A-18
- ″Save Outputs″ on page A-19
- ″Print Outputs″ on page A-19
- Exit

Graph Plots

Use this option to open the RMS Graphs window (Figure A.9) where a channel(s) appear in RMS format for the voltage and current signals. The RMS is calculated using a one cycle sliding window and then uses five cycles of information for smoothing.

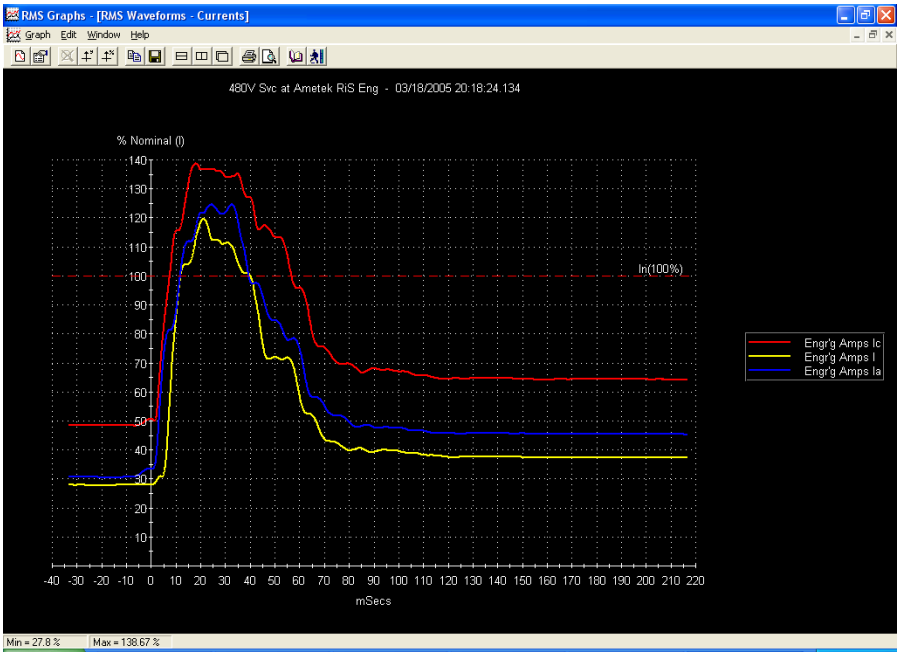

Figure A.9 RMS Graph Plot

Graph Plots Operations

To open the RMS Graph window:

1. Open the window by:

- Selecting *Expert > Graph Plots* in the Expert System main window.
- Clicking **Graph Plots** from the Expert System main window.
- Selecting *Graph > New Graph* from the RMS Graphics main window.

The RMS Graph Selection dialog appears (Figure A.10)

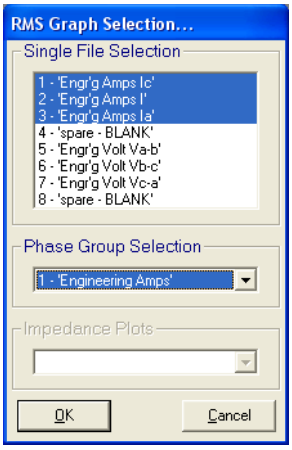

Figure A.10 RMS Graph Selection

2. Select the channel(s) for display. Either select:
   - Individual channels by clicking on the name.
   - The three channels that make up a phase group by picking a group from *Phase Group Selection*.

NOTE

Only channels with the same unit type (i.e. Volts or Amps) can appear on the same graph.

3. Select an *Impedance Plot,* if required.

The RMS graph appears with the selected channels shown.

Classify Fault

Use this function (Figure A.11) to classify a fault.

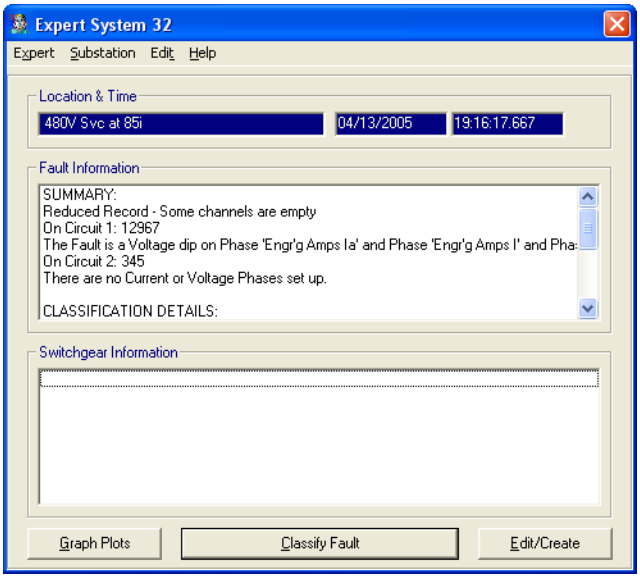

Figure A.11 Classify Fault

Buttons and Fields

Location & Time Displays the location and time for the record in use.

Fault Information

Displays the output from the classification of the fault type including, the fault current, and the voltage depressions of the faulted circuit(s). A one line summary of the fault record is followed by detailed data measurements including:

- The trigger cause from the record header information.
- The fault type. e.g. Phase A to Ground
- The over current level in Amps
- The voltage depression expressed as a percentage of the nominal voltage.

The types of values determine depends on the contents of the fault record file.

Switchgear Information

Displays classification information on the appropriate Digital Inputs including Relay and Switchgear operation times. Time limits, set in the Substation Details window, are used in the classification to determine whether the relay and the switchgear operated within these limits

Fault Classification Operations

To classify a fault:

1. Click either:

- **Classify Fault** on the Expert System 32 window

  or

- Select *Expert Classify Fault.*

NOTE

An error message can occur. Click OK to clear the message and resolve any problems before reclassifying.

2. Click **OK**.

Export Switchgear

Use this menu option to enable/disable the updating of the Switchgear database, if available. Uncheck this menu item to prevent automatic updating on fault classification.

The database must already be set up for the current location and circuit(s) in order to accept this data. See "Substation Menu" on page A-19.

NOTE

The Switchgear database is only updated if the classifier has detected a switchgear operation.

Export Switchgear Operations

To configure:

- Select *Expert > Export Switchgear* and the check mark is enabled/disabled.

Export Dips

This menu option enables/disables the updating of the Voltage Dip database, if available. Uncheck this menu item to prevent automatic updating on fault classification.

NOTE

The Voltage Dip database is only updated if the classifier has detected a voltage dip event.

Export Dips Operations

To configure:

- Select *Expert > Export Dips* and the check mark is enabled/disabled.

Save Outputs

Use this menu option to save all out puts to a text (*.txt) file.

Save Outputs Operations

To perform this:

1. Select *Save Outputs* and a Save As dialog appears.
2. Navigate to the directory, enter a name and click **Save**.

Print Outputs

Use this menu option to print all outputs to a printer.

Print Outputs Operations

To perform this:

1. Select *Print Outputs* and a Print dialog appears.
2. Configure as required and click **Print**.

Substation Menu

This menu consists only of Edit/Create Details.

Phase Group Channels

Use this window (Figure A.12) to configure the phase group channels for the breaker. This window is accessed throughout the configuration of circuit details and is produced here for reference.

Phase Group Channels Operations

To configure:

1. Click **Phase Groups** and the dialog appears (Figure A.12).

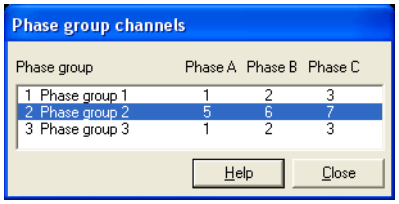

Figure A.12 Phase group channels

2. Configure the *Phase group channels* by:

   a. Clicking **Phase group** and the dialog appears (Figure A.13).

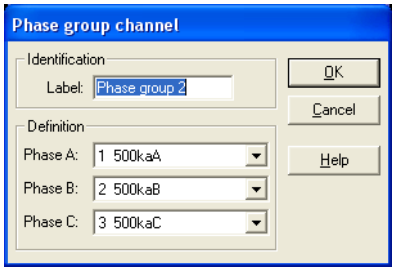

Figure A.13 Phase group channel

   b. Enter a *Label*.

   c. Select *Definitions* for all phases.

   d. Click **OK**.

   The Phase group channels dialog reappears.

3. Click **Close** and the Substation Details window reappears.

Edit/Create Details

Each time the fault classifier runs the Substation Configuration File is loaded. If this file is not available, or is corrupted, the Substation Details window appears (Figure A.14). Use this window to enter the details of the location. This information must be available for a classification to occur.

The substation details assume that the recorder is recording at least one voltage phase group and one current phase group. These could be the bus bar voltages and the summated transformer currents. A number of outgoing feeders can be monitored and the Expert System is best used when the protection relays and switchgear for each feeder are connected to the digital inputs.

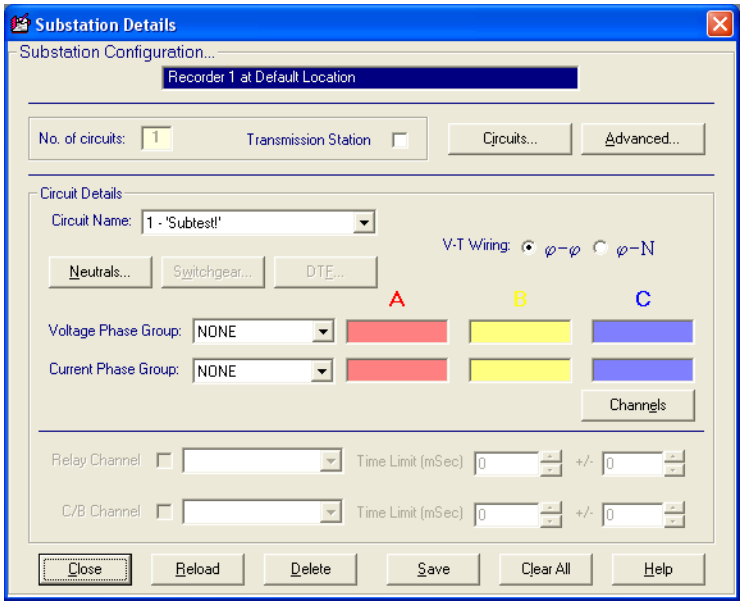

Figure A.14 Substation Details

Buttons and Fields

Substation Configuration

Displays the recorder the substation name.

Save — Saves all data.

Clear all — Clears all the fields. Click Clear all and then Reload to recover newly entered information that has not been saved.

Delete — Erases the Substation Configuration File, which may be required if a recorder is moved from one substation to another.

Advanced — Opens the Classifier Thresholds window to fine tune the fault classifier ("Classifier Thresholds" on page A-25).

Circuits — Opens the Edit Circuits window to add/edit circuits. See "Edit Circuits" on page A-24.

No. of circuits — Displays the number of out going feeders connected at the location. The names and digital channel inputs must be specified separately for each feeder.

Transmission Station Indicates whether the recorder is connected to a Transmission station or Distribution station. This information is required for DTF calculations.

VT Wiring Select phase - phase (Ø - Ø) if phase-to-phase voltage transformers are connected at the inputs. If phase to neutral voltage transformers are connected at the inputs then select phase - neutral (Ø - N).

Neutrals Opens the Neutral Inputs dialog to specify whether or not to monitor neutral currents and voltages.

Circuit Details Enter the details for each outgoing feeder.

DTF Opens the DTF - Transmission Line Model Details. See "DTF - Transmission Line Model Details" on page A-30.

Circuit Name Select the number of the feeder up to the value determined in No of circuits.

Voltage/Current Phase Group

Select the Phase Group that represents the Voltage Phase Group or Current Phase Group for the selected circuit number. The channel names appear in the boxes to the right. The classifier needs to know which inputs are voltages and which are currents.

Channels Opens the Phase group channels for configuration. See "Phase Group Channels" on page A-19.

Relay Channel Click the check box and select a digital input channel. If a protection relay contact is connected to the recorder this includes relay information in the classification. Either the pick up or trip auxiliary output is used but the fixed operate time should reflect the output in use. The digital input configuration in Display Station can be used to select the normal state of the relay.

Switchgear channel (C/B Channel)

Click the check box and select a digital input channel that represents the Circuit Breaker. If an auxiliary switchgear contact is connected to the recorder this includes Switchgear information in the classification. The digital input configuration in Display Station can be used to select the normal state of the relay.

Time limit — Enter a value that represents the time at which the Relay output or Switchgear operates after the fault detection. It is set in milliseconds (mSecs). e.g. the Relay is required to operate 10 mSecs after fault occurrence and the Relay/Switchgear is required to operate 55 mSecs after fault occurrence. This value is only considered if the relay has operated during the fault.

Tolerance — Enter a tolerance related to the Time Limit.

Switchgear — Opens the Circuit Breaker window to set up the present circuit in the Switchgear database. See "Circuit Breaker" on page A-28.

Neutral Inputs — Opens the Neutral Inputs dialog ("Neutral Inputs" on page A-27) to specify if neutral inputs are present.

Substation Details Window General Operations

This is the general procedure for configuring this window:

1. Add a circuit. See "Edit Circuits" on page A-24.
2. Set classifier thresholds. See "Classifier Thresholds" on page A-25.
3. Configure neutral inputs. See "Neutral Inputs" on page A-27.
4. Configure circuit breaker issues. See "Circuit Breaker" on page A-28.
5. Configure line details, if required. See "DTF - Transmission Line Model Details" on page A-30.
6. Configure phase group channels. See "Phase Group Channels" on page A-19.
7. Configure the details on the Substation Details window.

Edit Circuits

Use this window (Figure A.15) to add/edit circuits.

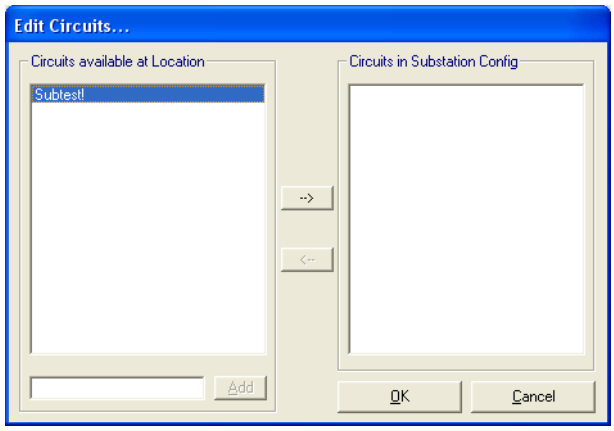

Figure A.15 Edit Circuits

Buttons and Fields

Circuits available at Location

List the circuits previously added or just added.

Circuits in Substation Config

List circuits linked to this substation.

Add — Adds a circuit name entered in the field to Circuits available at Location.

Arrows — Toggles circuits between the lists.

Edit Circuits Operations

To configure:

1. Click **Circuits** on the Substation Details window.
2. Type a name in the *Add* field and click **Add**.

   It appears in Circuits available at Location.
3. Select the circuit in *Circuits available at Location*.
4. Click the right arrow.

   It appears in Circuits in Substation Config.
5. Click **OK**.

The Substation Details window reappears.

Classifier Thresholds

Opens the Classifier Thresholds window to fine tune the fault classifier (Figure A.16).

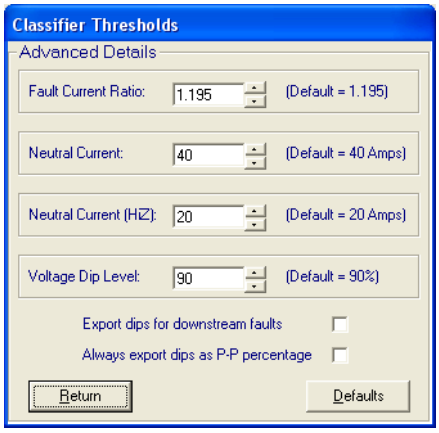

Figure A.16 Classifier Thresholds

Buttons and Fields

Fault Current Ratio — Enter a ratio. The fault ratio compares the pre-fault and in-fault values and uses this ratio to determine if there is a fault condition. If the classifier is not detecting a fault on a phase where it should, decrease the Fault Current Ratio. The default is 1.195. For example, the Post fault current on a phase must be at least 1.195 times the Pre-fault current for a fault on that phase to be detected.

Neutral Current — Enter a value. If the classifier is not detecting a ground or neutral current properly, decrease the Neutral Current value to make it more sensitive. This value represents the post fault neutral current above the pre-fault neutral current in Amps.

The Neutral Current (HiZ)

Sets a threshold (the default is 20 Amps) for a high impedance earth fault. If the classifier cannot detect fault current or a voltage dip it checks the neutral channel, if available, for a high impedance earth fault.

Voltage Dip Level — Set the voltage dip level as a percentage. The RMS nominal voltage is compared with the RMS in-fault value. The pre-fault is not considered.

Export dips for downstream faults

Enables the export of Voltage Dip information to the Voltage Dips Database, even when overcurrent/downstream faults are detected.

Always export dips as P-P percentage

Forces the dips that are exported to the voltage dips database to always be in the Phase-Phase format, irrespective of the type of V-Ts connected. Circuits with Phase-Neutral V-Ts have voltage waveforms that are Phase-Neutral. These are converted to Phase-Phase by the Expert System before export to the Phase-Phase voltage.

Defaults — Resets the Fault Current Ratio, the Neutral Current, and the Neutral Current (HiZ) to their default values of 1.195, 40, and 20, respectively.

Classifier Thresholds Operations

To configure:

1. Click **Advanced** on the Substation Details window.

The Classifier Thresholds window appears (Figure A.17).

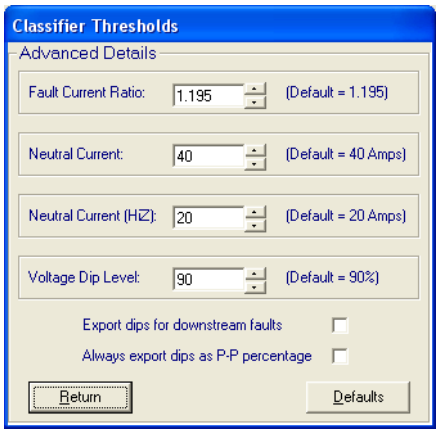

Figure A.17 Classifier Thresholds

2. Select a value, as required, for:

- *Fault Current Ratio*
- *Neutral Current*
- *Neutral Current (HiZ)*
- *Voltage Dip Level*

3. Click **Export dips for downstream faults**, as required.
4. Click **Always export dips as P-P percentage**, as required.
5. Click **Return** and the Substation Details window reappears.

Neutral Inputs

Opens this dialog (Figure A.18) to specify if neutral inputs are present. Both the voltage and neutral current inputs can be specified. If these are available, the fault classifier can also check for ground faults. The neutral details are saved along with the details from the Substation Details window.

Buttons and Fields

Voltage Neutral — Select a voltage channel label that represents the neutral voltage input.

Current Neutral — Select a current channel label that represents the neutral current input.

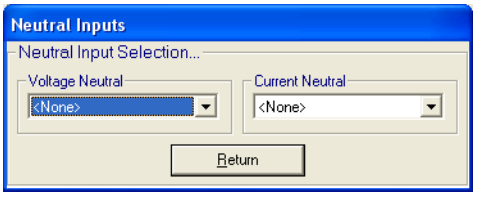

Figure A.18 Neutral Inputs

Neutral Inputs Operations

To configure:

1. Click **Neutrals** and the Neutral Inputs dialog appears (Figure A.18)
2. Select a *Voltage Neutral* and/or *Current Neutral*.
3. Click **Return** and the Substation Details window reappears.

Circuit Breaker

This window (Figure A.19) sets up the present circuit in the Switchgear database, if available. This allows the exporting of switchgear operations to the database. If the details have already been entered for the circuit, they appear and cannot be edited. To edit the details, use the *B*reaker Performance Monitor database viewer, if available. See "BPM Menus and Windows" on page A-61.

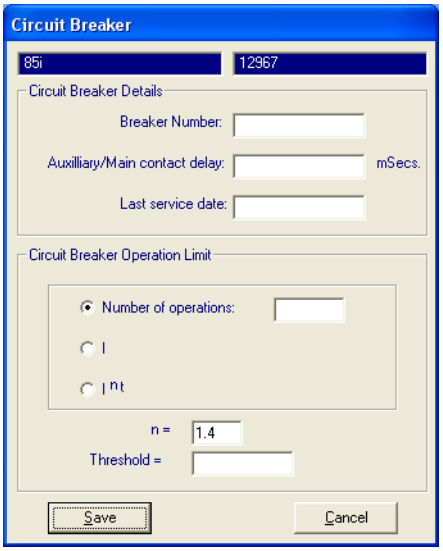

Figure A.19 Circuit Breaker

Button and Fields

Substation/Feeder names

Appears at the top of the window for reference.

Circuit breaker details

Breaker number (or asset number

Enter a reference for each piece of switchgear.

Auxiliary/Main contact delay

Enter a time. Used as a way for determining an accurate time for the parting of the main contacts. This time (in milliseconds) is the difference in time from the sensed auxiliary contacts changing state until the main contacts open. This value can be negative as well as positive.

Last Service Date

Specify which breaker operations to included when calculating the maintenance time. All operations before this date are ignored. When a breaker is serviced, enter its service date.

Circuit Breaker Operation limit

Click a radio button to set the operation limit.

Breaker Performance Monitor (BPM) has three ways of determining the maintenance interval for switchgear. These are:

- *Number of operations*
- *Accumulated current* (current counter) (I)
- *Dissipation function* ($I^n t$) or duty or contact wear

The dissipation function has been promoted in recent years as a more accurate method of determining service life. The function $I^n t$ is used to estimate contact wear by measuring the energy in the arc as the contacts open. A value of n = 2 was the original guess but operation experience suggests that a value of 1.6 may be more accurate. The choice of maintenance interval measurement for each circuit breaker and the value of the power *n* are determined by operational experience and consultation with the manufacturer.

Number of Operations

Enter the threshold value for no. of operations mode.

n Enter the value for n, the exponent in $I^n t$.

Threshold Enter the threshold for the breaker.

Circuit Breaker Operations

To configure:

1. Configure the *Circuit Breaker Details* by:

- Entering a *Breaker Number*.
- Entering an *Auxiliary/Main Contact Delay*.
- Entering a *Last service date*.

2. Configure the *Circuit Breaker Operation Limit* by:
3. Clicking either:
    - **Number of operations** and entering a value in the field.
    - **I**
    - **Int**

NOTE

BPM tracks all three parameters in the database and you can switch between these values within the BPM program.

4. Enter *n*.
5. Enter a *Threshold*.
6. Click **Save**.

   The Substation Details window reappears.

DTF - Transmission Line Model Details

Use this window (Figure A.20) to set up the basic information for the circuit line model. Use the Line and Line-to-line buttons to access windows to enter the 3-Phase base value in MVA's and also Line-Line base in KV's. The parameter types for the line are selected, as well as that for the Local and Remote source.

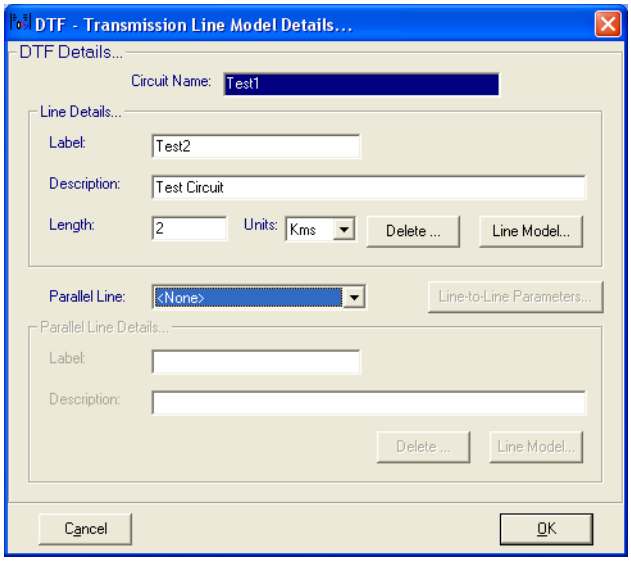

Figure A.20 DTF - Transmission Line Model Details

Buttons and Fields

Circuit Name	Displays the circuit name for configuration.
Line Details	
Label	Enter a label.
Description	Enter relevant information about the line.
Length	Enter a length
Unit	Select a unit: • *Kms* • *Miles*
Parallel Line	Select a parallel line circuit, if available.
Description	Enter relevant information about the line.
Line Model	Opens the DTF Line Model window.
Delete	Deletes the selected detail.

DTF - Transmission Line Model Details Operations

To configure:

1. Click **DTF** on the Substation Detail window and the DTF - Transmission Line Model Details appears (Figure A.20).
2. Configure *Line Details* by:
   - Entering a *Label*.
   - Entering a *Description*.
   - Enter a *Length* and select *Units*.
3. Click **Line Model** and the Line Model Impedance Data Sheets window appears (Figure A.21).

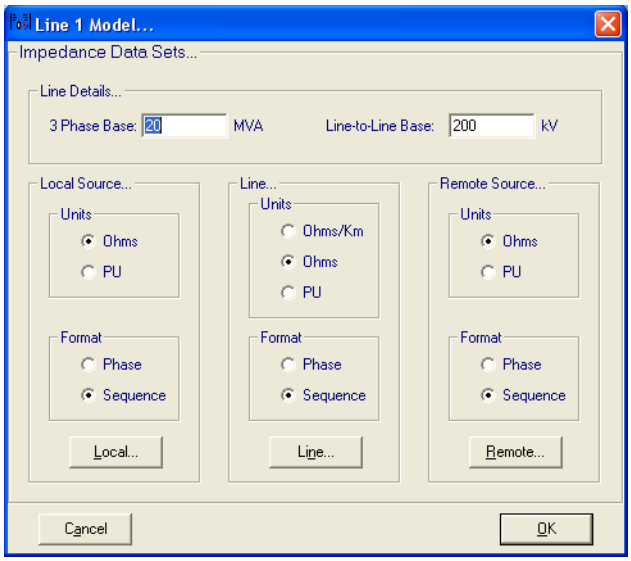

Figure A.21 Line Model Impedance Data Sheets

4. Configure *Line Details* by:
   - Entering a *3 Phase Base* value.
   - Entering a *Line-to-Line Base* value.
5. Configure *Local Source* by:
   - Clicking a *Units* radio button:
     - **Ohms**
     - **PU**
6. Clicking a *Format* radio button:
     - **Phase**
     - **Sequence**
7. Click **Local** and a Line Impedance Components dialog appears (Figure A.22 or Figure A.23).

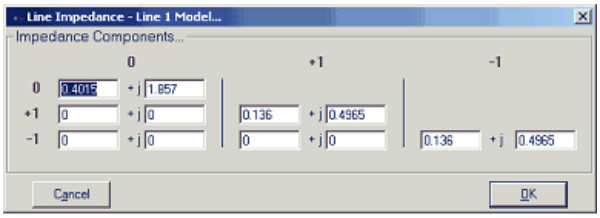

Figure A.22 Line Impedance Components: Sequence Format

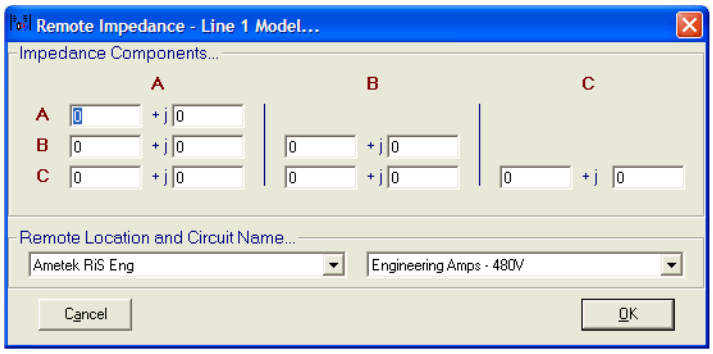

Figure A.23 Line Impedance Components: Phase Format

8. Enter values per phase.

   If the phase component form is used, the individual and mutual impedances are required.

9. Click **OK**.

10. Repeat steps 6 through 9 for *Line* and *Remote Source*.

NOTE

For Remote Source there are two additional drop downs:

- **Remote Location**
- **Circuit Name**

Configure these as well.

11. Click **OK** and the DTF - Transmission Line Model Details window reappears.

12. Select a *Parallel Line*, if available.

13. Enter Parallel Line Details by:

    - Entering a *Label*.
    - Enter a *Description*.

14. Click **Line-to-Line Parameters** and the window appears (Figure A.24).

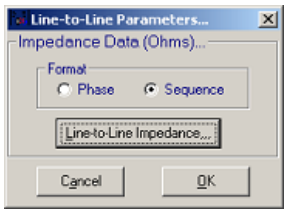

Figure A.24 Line-to-Line Parameters

15. Click a *Format* radio button:
    - **Phase**
    - **Sequence**

NOTE

For double-ended line models:

Enter the data in the order:

- **Phase group details for the local end recorder in ES**
- **Phase group details for any parallel circuit**
- **Phase group details for the remote end recorder in ES**
- **Phase group details for any parallel circuit**
- **The line model for the local end recorder**

16. Click **Line-to- Line-Impedance** and the window appears (Figure A.25). DTF32 does not assume that the two lines have identical impedances. The mutual coupling between the lines is also entered.

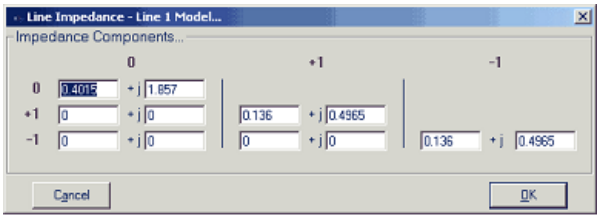

Figure A.25 Line Impedance Components

17. Enter values per phase.

    If the phase component form is used, the individual and mutual impedances are required.

18. Click **OK** and the Line-to-Line Parameters reappears.

19. Click **OK**.

    A dialog appears.

20. Click **Yes** and the Substation Details window reappears.

Edit Menu

This menu consists only of Copy Outputs.

Copy Outputs

Use this to copy the record to the clipboard for use in a text editor.

Copy Outputs Operations

To use this:

1. Select *Edit > Copy Outputs*.
2. Paste into a text editor.

Help Menu

The Help menu consists of:

- ″Help″
- ″About″

Help

The information in the application Help is mostly duplicated in this manual.

To open help:

- Select Help
- Select *Help > Contents* the main index page for the help system appears.
- Select *Help > Searching for help on* and the search window for the help system appears.
- Select *Help > Using Help* and the main contents page for the help system appears.

About

This dialog (Figure A.26) contains copyright and licensing information for the product together with its version number. When seeking support you may be asked to provide some of the information found here.

To display this dialog:

- Select *Help > About* and the dialog appears (Figure A.26).

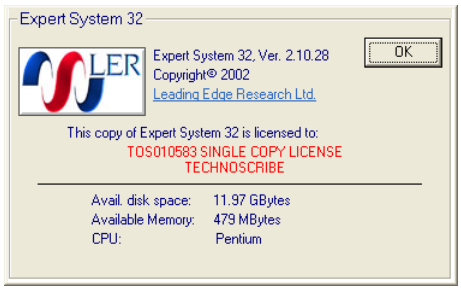

Figure A.26 About Expert System

Distance to Fault Menus and Windows

Substation model

Before the distance to fault is calculated, the line length and impedance must be defined. This is done inside the Expert system as part of the Substation Model. For DTF to be available, the substation must be defined as a Transmission station by checking the relevant box, and the VT Wiring must be defined as phase to neutral (-N). See "Edit/Create Details" on page A-20.

If the voltage and current phase groups have not been previously defined, use Channels to set up the groups. See "Neutral Inputs" on page A-27.

Figure A.27 shows the Distance to Fault main window.

Access this window by:

- Selecting *Tools* > *Distance to Fault* 32 in DSA.

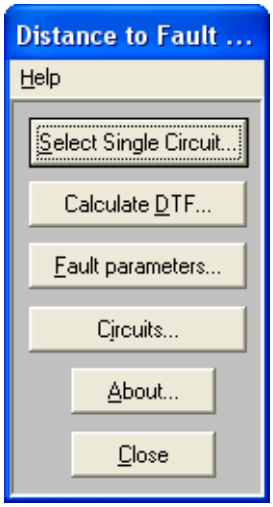

Figure A.27 DTF Window

This window accesses the DTF functionalities:

Select Single Circuit	Opens the Select Transmission Circuit ID window ("Select Single Circuit" on page A-38).
Calculate DTF	Calculates the DTF values ("Calculate DTF" on page A-39).
Fault Parameters	Opens the Fault parameters window ("Fault Parameters" on page A-41).
Circuits	Opens the Transmission Circuits window ("Circuits" on page A-42).

About	Opens the About dialog.
Close	Closes DTF.

Select Single Circuit

Use this window (Figure A.28) to designate a circuit for DTF use.

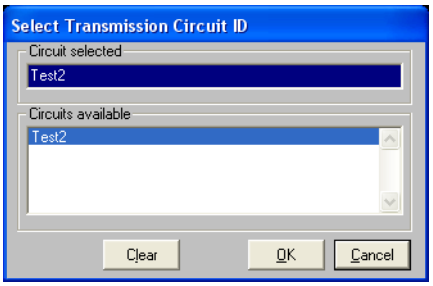

Figure A.28 Select Transmission Circuit ID

Buttons and Fields

Circuit Selected	Displays the circuit selected.
Circuits available	Displays available circuits.
Clear	Clear selected circuits from the Circuits available.

Select Transmission Circuit ID Operations

To select a circuit:

1. Click **Select Single Circuit** and the Select Transmission Circuit ID window appears (Figure A.28).
2. Select a *Circuits available*.
3. Click **OK**.

Calculate DTF

Use this option to start the DTF algorithm. which:

- Looks at the current channels defined by the phase groups and accurately determines the start and end of the fault period.
- Moves the two cursors in the DSA graphics display to these points.
- Finds the faulted phase(s).
- Selects the type of fault (phase - neutral, phase - phase, etc.).
- Measures the fundamental pre-fault and fault currents with the voltages during the fault.
- Computes the fault impedance and, knowing the line impedance, the distance to the fault is determined.

To improve the accuracy of the result, the fault distance is computed a number of times during the period that the fault current is flowing and the answers averaged. This mean value with the standard deviation appears with the fault type. The positions of the start and end of the fault relative to the record trigger time also appear.

Fault Impedance

The average impedance during the fault is also measured by the system. The impedance appears in the Average Resistance and Average Reactance boxes, and represents the computed phase-neutral impedance of the faulted phase selected by the fault classifier. In the case of a multi-phase fault (either phase-phase or phase-neutral), the reference phase quantity defined as the *leading* phase in the phase group definition used by the classifier, is used in the impedance algorithm.

Ordinarily, the computed impedance quantity gives an indication of the average fault-impedance during a typical line fault. However, the average fault impedance provides additional information for fault location in complex network connections such as those encountered in distribution networks.

The standard deviation of the results can be treated as a reliability figure. The smaller the standard deviation, the more certain the result. If the deviation is large, it is probable that the computed distance is unreliable and the fault classifier may have picked the wrong fault type. If this is the case, override the fault type and recompute the fault distance. See "Fault Parameters" on page A-41.

Calculate DTF Operations

To calculate DTF:

1. Ensure that a model is created or selected. See "Substation model" on page A-37.
2. Click **Calculate DTF**.

   The DFT 32 Results window appears (Figure A.29).

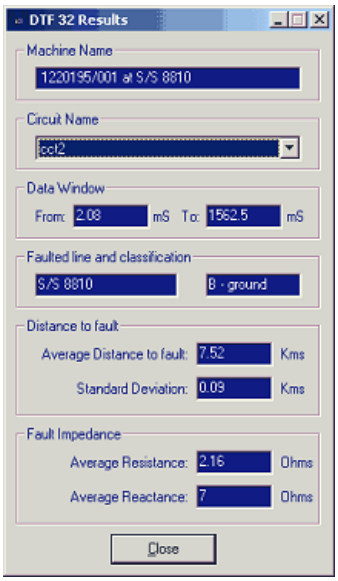

Figure A.29 DTF 32 Results

The DTF 32 Results window displays calculation results. Use the Circuit Name drop down to view results for different circuits.

Fault Parameters

Use this window (Figure A.30) to change the fault type and the position of the cursors that determine the start and end of the fault current, and recompute the distance once the system has completed the automatic calculation. This manual calculation overrides the automatic fault classifier. This facility is useful for removing the initial burst of fault current that may include arcing and so increase the standard deviation of the distance result.

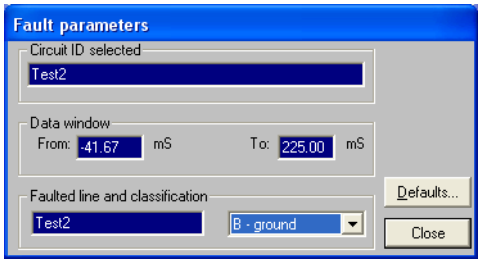

Figure A.30 Fault Parameters

Buttons and Fields

Circuit ID selected — Displays the circuit in use.

Data window — Displays the From and To time in msecs.

Faulted line and classification — Displays the line tested and classification data. Use the drop down to select this line.

Defaults — Resets the automatically generated values.

Fault Parameters Operations

To manually operate the DTF calculation:

1. Click **Fault Parameters** and the Fault parameters window appears (Figure A.30).
2. Select a *Faulted line and classification*.
3. Use the left and right mouse buttons move the cursor positions to select an alternative fault position.
4. Click **Close** and click **Calculate DTF** to re-compute the distance.

Circuits

Use this window (Figure A.31) to create a transmission line model for each circuit in a transmission substation. The line model allows for a single or double line to be defined. For each line, a label and description can be entered, used to discriminate between the two lines for manual parameter selection. The line length is entered in miles or kilometers and represents the true length, not the distance over the ground. The actual impedance model can also be entered.

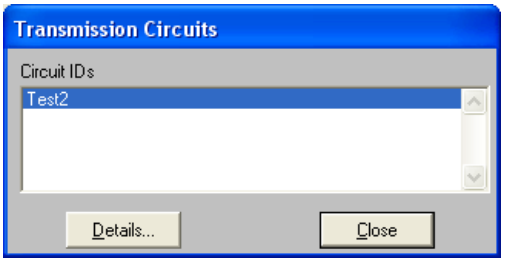

Figure A.31 Transmission Circuits

NOTE

The accuracy of the distance to fault calculation depends on the accuracy of the line model. Ensure that the impedance values are as accurate as possible.

For each line, the line impedance must be entered. If the local and remote source impedances are known, they are also entered for improved accuracy. In most cases, the sequence component form of the impedances are known but individual phase impedances can also be used. If Per Unit values are being used, the base MVA and line-to-line voltage must be entered.

For each of the three impedances - local, line and remote - the zero, positive and negative values are all required. These are entered in the form R + jX. The off diagonal values are not required, but maintain compatibility with the phase component form of the impedance. In most cases, the positive (+1) and negative (-1) sequence impedances are the same.

Viewing line models

When DTF32 is run from DSA32, view the line models by:

Clicking **Circuits**. The model cannot be changed here. This is done from the Expert System Substation model.

Transmission Circuits Operations

To configure this:

1. Click **Circuits** and the Transmission Circuits window appears (Figure A.31 on page -42).
2. Select a *Circuit ID*.
3. Click **Details**.

   The DTF-Transmission Line Model Details window appears. Refer to ″DTF - Transmission Line Model Details Operations″ on page A-31 for the remainder of this procedure.

Exit DTF

To exit the DTF program:

- Click **Close** in the main DTF window.

Voltage Dips Windows and Menus

The Voltage Dips menu consists of:

- "System Menu" on page A-46
- "Database Menu" on page A-55
- "Edit Menu" on page A-57
- "Help Menu" on page A-57

Voltage Dips Analysis Main Window

Figure A.32 shows the main window.

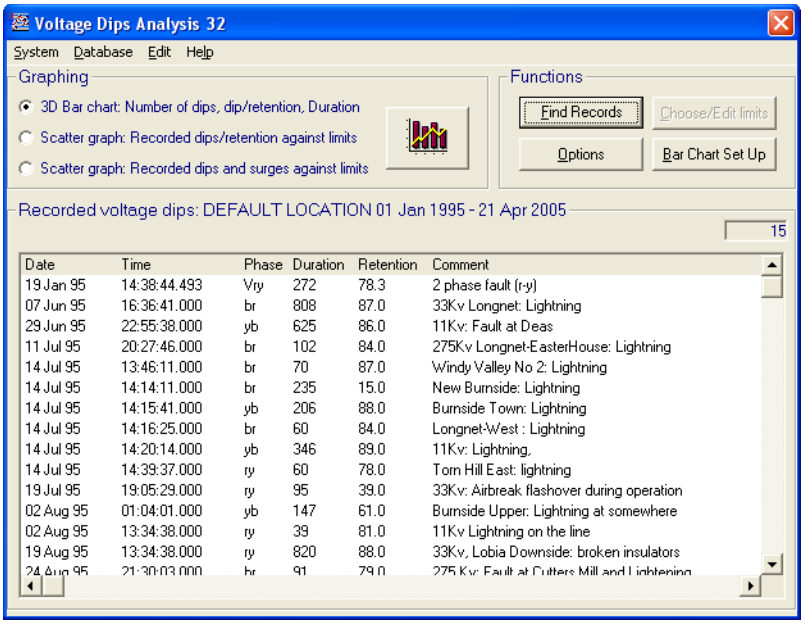

Figure A.32 Voltage Dips Analysis 32 Main Window

Buttons and Fields

List	Displays the list of filtered events for use in graphing.
3D Bar Chart	Displays the voltage dip information as the number of dips that occurred between the defined start and end dates. This is graphed against the duration of the dips and the magnitude of the dip itself, expressed as a percentage of the Nominal Voltage. See "Bar Chart Set Up" on page A-52.

Scatter graph, Dips against limits

Displays the voltage dips as dots on a scatter graph and draws a curve on the graph showing the defined limits. Those dips which fall above or below the curve, depending on whether percentage dip or retention is used ("Options" on page A-49), therefore fall outside their allowable limits.

Scatter graph, Dips and Surges against limits

Displays the same information as the other scatter graph but includes surges of voltage. With this option only percentage voltage retention can be graphed at this time.

Graph Operations

Create a graph

To draw one of the graphs:

1. Click the appropriate radio button.
2. Click  .

Details

Use this window (Figure A.33) to edit values for an event before opening a graph or to delete an event.

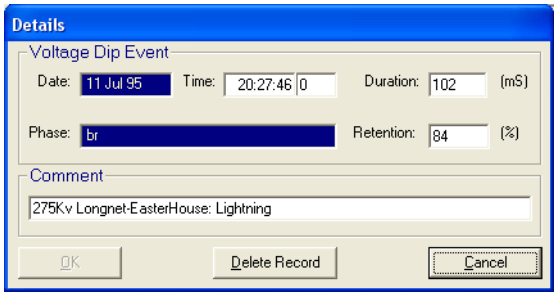

Figure A.33 Voltage Dips Details

Buttons and Fields

Date	Displays the event date
Phase	Displays the phase.
Time	Edit the time.
Duration	Edit the duration.

Retention	Enter the percentage.
Comment	Edits the comment.
Delete	Deletes a record.
OK	Enter changes for use in graphing.

Details Operations

To configure details:

1. Double-click on a record in the main window.
   The Details window appears (Figure A.33).
2. Edit active fields, as required.
3. Click **OK**.

The main window reappears.

System Menu

This menu consists of:

- "Find Records" on page A-47
- "Options" on page A-49
- "Choose/Edit Limits" on page A-50
- "Bar Chart Set Up" on page A-52
- "Print Preview/Print Record List/Print Setup" on page A-54
- "Exit" on page A-54

Find Records

Use this window (Figure A.34) to define which voltage dip records to display.

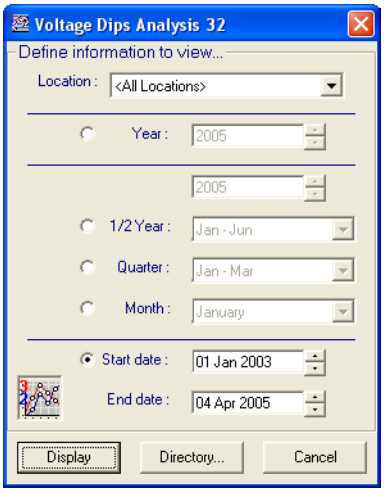

Figure A.34 Voltage Dips Analysis 32 - Record Selection

Buttons and Fields

Location	Select a location.
Date Selection	Click a radio button: • *Year* - select a year • *Unmarked drop down* - select a year for the 1/2 Year, Quarter and Month fields. • *1/2 Year* - select a time range • *Quarter* - select a time range • *Month* - select a month • *Start date* - select a Start date and End date. Hold *<Shift>* down as well a date spinner and the date jumps by thirty days at a time.
Display	Extracts the required data records and opens them on the main window.
Directory	Open a dialog (Figure A.35) to enter a path name for the database.

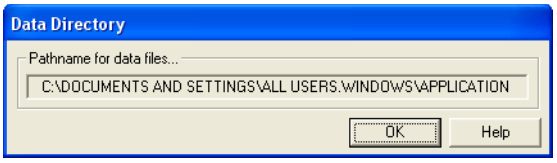

Figure A.35 Data Directory

Find Records Operations

To access a voltage dip record:

1. Click on the Voltage Dips icon or select it from the Start menu.

The Voltage Dips Analysis 32 Define information to view window appears (Figure A.36) to filter records.

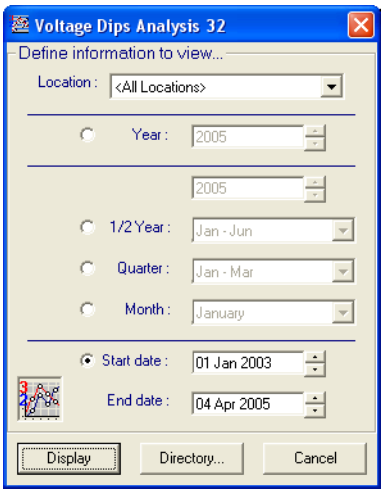

Figure A.36 Voltage Dips Analysis 32 - Record Selection

2. Select a *Location*.

3. Click a radio button:

- **Year** - select a year
- **1/2 Year** - select a year in the unmarked drop down and select a time range
- **Quarter** - select a year in the unmarked drop down and select a time range
- **Month -** select a year in the unmarked drop down and select a month
- **Start date - select a** *Start date* **and** *End date*

4. Click **Display** and the Voltage Dips Analysis 32 main window appears (Figure A.37).

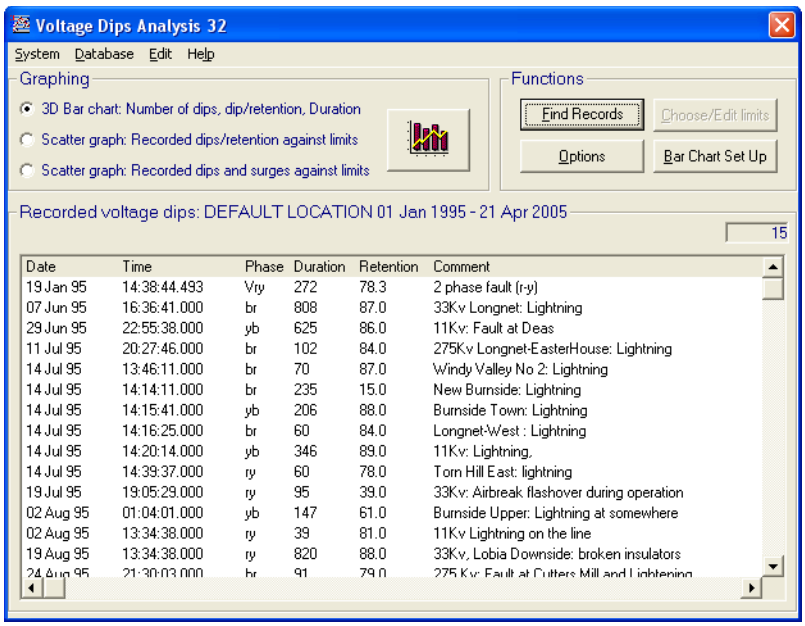

Figure A.37 Voltage Dips Analysis 32 Main Window

Options

Use this dialog (Figure A.38) to select the voltage dip display option. The voltage events are always viewed as percentages. The default is the percentage of the nominal voltage retained.

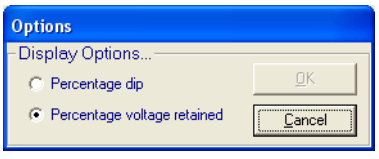

Figure A.38 Voltage Dips Options

Buttons and Fields

Percentage Dip Sets events to appear graphed as percentage dipped.

Percentage voltage retained

Sets events to appear graphed retaining percentage voltage.

Options Operations

To set options:

1. Open *Options* by:
   - Clicking **Options** on the main window.
   - Selecting *System > Options*.

   The dialog appears (Figure A.38).
2. Click either:
   - **Percentage Dip**
   - **Percentage voltage retained**
3. Click **OK**.

NOTE

This option is not available for the Dips and Surges Scatter Graph, which is always graphed in terms of voltage retention.

Choose/Edit Limits

Use this window (Figure A.39) to define a new or different limit curve for the creation of scatter graphs.

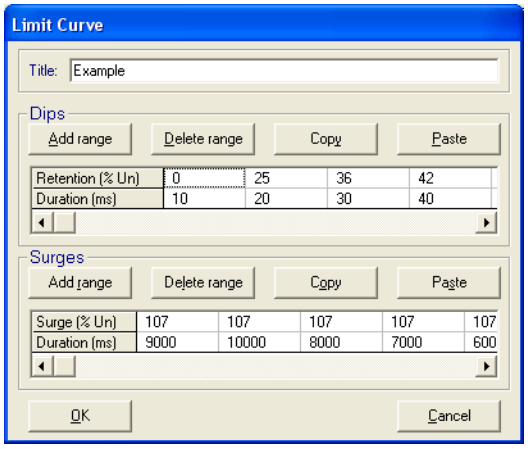

Figure A.39 Limit Curve

Scatter Graph limit curve definitions are stored as separate files with the extension .lmt, for example *cbema.lmt*. These define the percentage voltage retention (the Y coordinate of the curve) and duration in milliseconds (the X coordinate of the curve) for the points on the curve.

Buttons and Fields

	Title	Enter a title.
Dips		
	Add Range	Enter a value for Retention and Duration.
	Delete Range	Deletes the selected range.
	Copy	Copies the selected range.
	Paste	Paste the copied range.
Surges		
	Add Range	Add a range: an entry field for Surge and Duration.
	Delete Range	Deletes the selected range.
	Copy	Copies the selected range.
	Paste	Paste the copied range.

Choose/Edit Limits Operations

To configure limits:

1. Open Limit Curve by:
   - Clicking **Choose/Edit Limits** on the main window
   - Select *System > Choose/Edit Limits*.

   The Append Database window appears.
2. Navigate to and select a.*lmt* file.
3. Click **Open**.

   The Limit Curve window appears (Figure A.40).

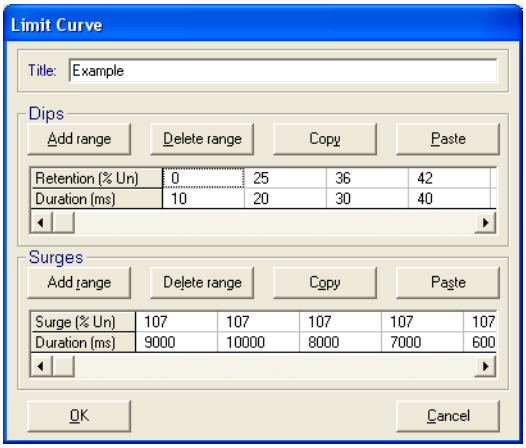

Figure A.40 Limit Curve

4. Enter a *Title*.
5. Configure *Dips* by:
   - Clicking **Add Range**.
   - Entering a *Retention* and *Duration* value.
   - Editing other fields, as required.
6. Configure *Surges* by:
   - Clicking **Add Range**.
   - Entering a *Surge* and *Duration* value.
   - Editing other fields, as required.
7. Click **OK**.

Bar Chart Set Up

Use this window (Figure A.41) to define a new or different set up for the creation of 3D bar charts.

Bar Chart set up definitions is stored as separate files with the extension .bar, for example *default.bar*. These define the ranges into which the dip data is graphed in terms of percentage voltage retention (the Z axis of the chart) and duration in milliseconds (the X axis of the chart).

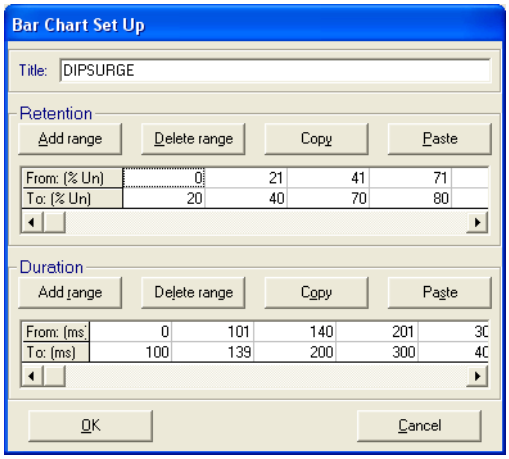

Figure A.41 Bar Chart Setup

The minimum number of retention ranges allowed is one, the minimum number of duration ranges allowed is two.

Buttons and Fields

	Title	Enter a title.
Retention		
	Add Range	Add a range: an entry field for From and To.
	Delete Range	Deletes the selected range.
	Copy	Copies the selected range.
	Paste	Paste the copied range.
Duration		
	Add Range	Add a range: an entry field for From and To.
	Delete Range	Deletes the selected range.
	Copy	Copies the selected range.
	Paste	Paste the copied range.

Choose/Edit Limits Operations

To configure limits:

1. Open Bar Chart Setup by:
   - Clicking **Bar Chart Setup** on the main window
   - Select *System > Bar Chart Set Up*.

   The Append Database window appears.
2. Navigate to and select a.*bar* file.
3. Click **Open**.

   The Bar Chart Setup window appears (Figure A.42).

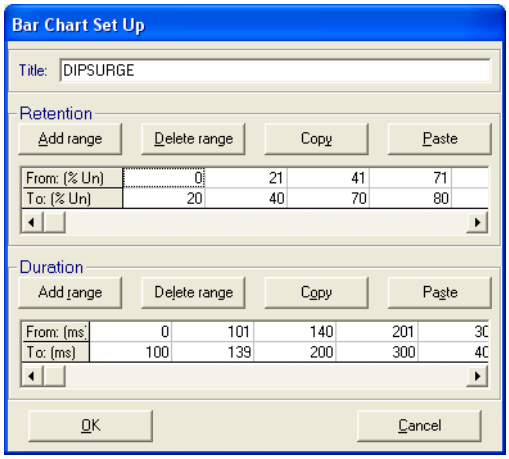

Figure A.42 Bar Chart Setup

4. Enter a *Title*.
5. Configure *Retention* by:
   - Clicking **Add Range**.
   - Entering a *From* and *To* value.
   - Editing other fields, as required.
6. Configure *Duration* by:
   - Clicking **Add Range**.
   - Entering a *From* and *To* value.
   - Editing other fields, as required.
7. Click **OK**.

Print Preview/Print Record List/Print Setup

Printing options include:

Print record list — Prints the contents of the record list in the main record list window, with its list of voltage dips/surges. If A4 paper is used, configure the print set-up options to change the printer page set-up to landscape.

Also, if printing on a monochrome printer instead of a color printer, redraw graphs in black and white using the Black and White option of the Color part of the Graph menu prior to sending the graph to the printer.

See "Print/Print Preview/Print Setup" on page 3-37 for procedures.

Exit

To close the application:

- Select *System > Exit*.

Database Menu

This menu consists of:

- ″Archive Records″
- ″Append Records″ on page A-56
- ″Compact Database″ on page A-56

Archive Records

Use this window (Figure A.43) to remove old records from the voltage dips database (dips.mdb) database and put them in an archive database.

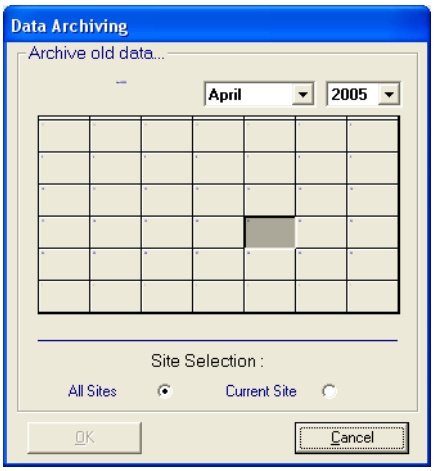

Figure A.43 Data Archiving

Archive Records Operations

To archive a database:

1. Select *Database > Archive Records*.
2. Enter a month and year using the drop downs.
3. Click a date in the calendar.
4. Click a *Site Selection* radio button:
   - **All Sites**
   - **Current Site**
5. Click **OK**.

   All records in the database that record voltage dip events that occurred before this date are removed from the database and placed into the archive database.

   An Archive Database window appears.

6. Navigate to a directory, enter a name and click **Open**.

NOTE

If the name already exists then a dialog ask whether to overwrite the existing database or append to it. Click:

- **YES and the records are appended.**
- **NO and the archive is over written.**

Append Records

Use this option to remove old records from the database and append them in an existing archive database.

If voltage dip records exist in a separate database, for example in an archive database, it is possible to return these records to the voltage dips database.

Append Database Operations

To archive a database:

1. Select *Database > Append Records*.

   An Append database window appears.

2. Navigate to the archive database and click **Open**.

Compact Database

Use this option to compact the database.

Append Database Operations

To compact a database:

1. Select *Database > Compact Database*.

   The Database Compacting dialog appears (Figure A.44).

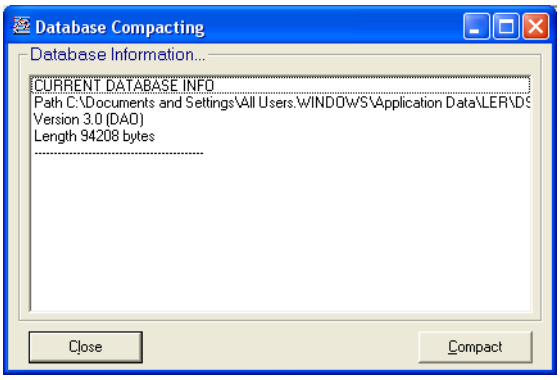

Figure A.44 Database Compacting

2. Click **Compact**.
3. Click **Close**.

Edit Menu

This menu consists only of Copy record list.

Copy record list

Use this function to copy the record list. Then it can be pasted into a text editor.

Help Menu

See "Help Menu" on page 3-114.

Graph Window

Figure A.45 shows the main graph window.

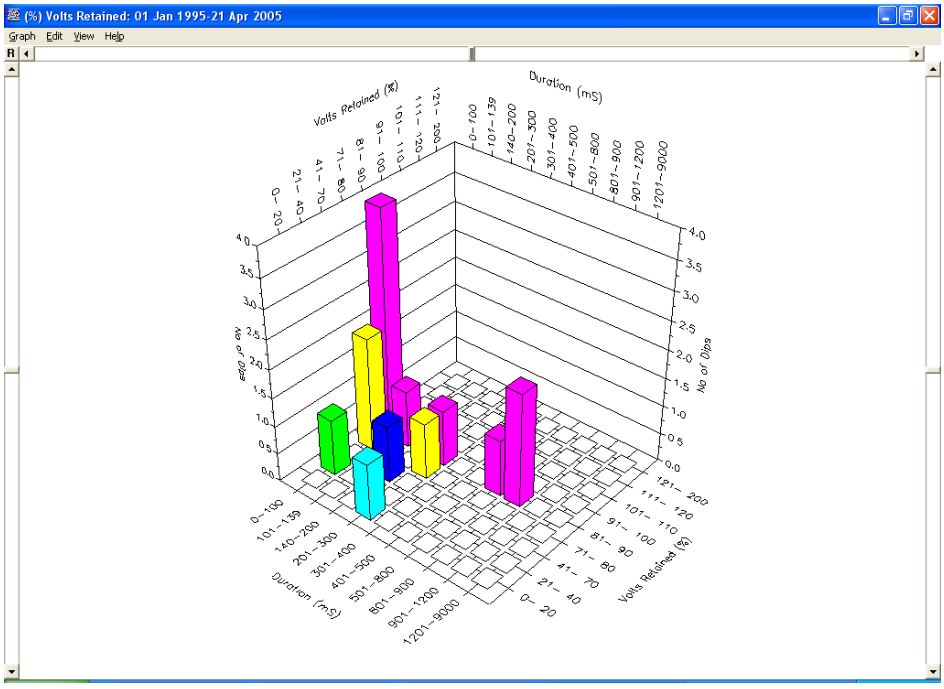

Figure A.45 Voltage Dips Graph Window

Voltage Dips Graph Window Menus

These menus are:

- "Graph Menu"
- "Edit Menu" on page A-60
- "View Menu" on page A-60
- Help

Graph Menu

This menu consists of:

- "Save Graph"
- "Look" on page A-58 - 3D Bar Chart only
- "Footer Label" on page A-58
- "Colors" on page A-59
- "Z-Axis Scaling" on page A-59 - 3D Bar Chart only
- "Legend/ Logarithmic" on page A-59 - Scatter only
- "Print/Print Preview/Print Setup" on page A-59

Save Graph

To save a graph as a .bmp or .wmf:

1. Click *Graph > Save Graph*.

   A Save As dialog appears.

2. Navigate to the directory, enter a file name and type and click **Save**.

Look

To change the look of the graph:

1. Click *Graph > Look*.

   A popup menu appears with three items:

   - *Surface Plot*
   - *Zoned*
   - *Contoured*

2. Select a type and the graph changes.

Footer Label

To add/change the footer:

1. Click *Graph > Footer Text*.

   A popup menu appears with three items:

   - *Label*
   - *Font*

   A dialog appears.

2. Enter the text and click **OK** and the text appears in the appropriate area.

Colors

To change the color of the graph:

1. Click *Graph > Color.*

   A popup menu appears with three items:

   - *Background*
   - *Foreground*

   A color dialog appears.

2. Click a color and click **OK** and the color changes.

Z-Axis Scaling

To change the scale:

1. Click *Graph > Z-Axis Scaling.*

   The Z-Axis Scaling dialog appears (Figure A.46).

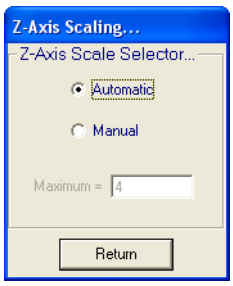

Figure A.46 Z-Axis Scaling

2. Click a *Z-Axis Scale Selector* radio button:

   - **Automatic**
   - **Manual** - enter a *Maximum* value

3. Click **Return** and the axis appears.

Legend/ Logarithmic

To toggle these on/off:

- Click *Graph > Legend or Logarithms.*

Limit Curves

See "Choose/Edit Limits" on page A-50.

Print/Print Preview/Print Setup

See "Print/Print Preview/Print Setup" on page 3-37.

Edit Menu

This menu consist of:

- Copy - see "Copy" on page 3-39/
- Bar Chart Set Up - "Bar Chart Set Up" on page A-52.
- Options - see "Options" on page A-49.
- Statistics - Scatter Graphs only

Statistics

Displays the Dip/Surge Statistics dialog for scatter graphs (Figure A.47).

Figure A.47 Dip/Surge Statistics

View Menu

This menu consists only of Data Graph.

Data Graph

Use this option to toggle on/off the data display on the bottom of graph (Figure A.48).

To toggle the data on/off:

- Select *View > Data Graph*.

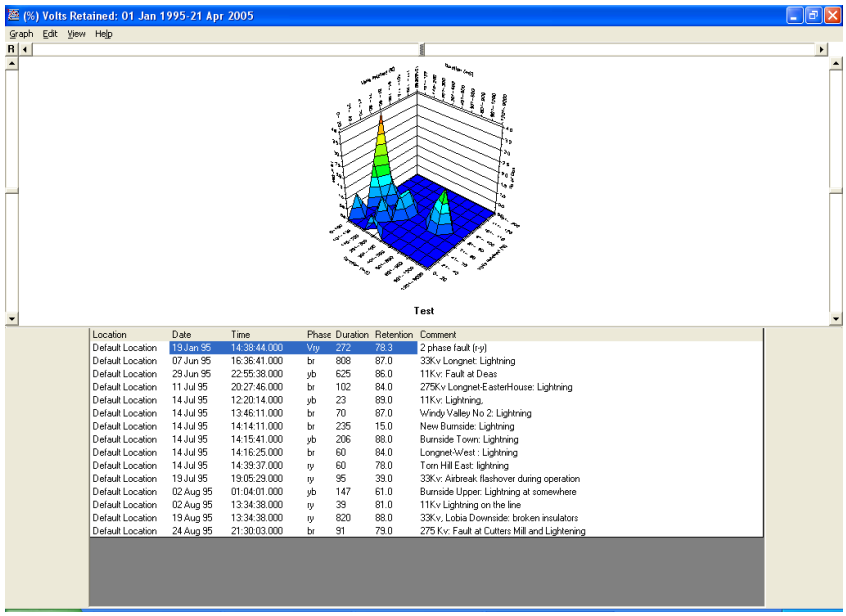

Figure A.48 Voltage Dips Graph with Data

BPM Menus and Windows

The Breaker Performance Monitor menu consists of:

- "System Menu"
- "View Menu" on page A-69
- "Help Menu" on page A-70

BPM Main Window

Figure A.49 shows the BPM main window.

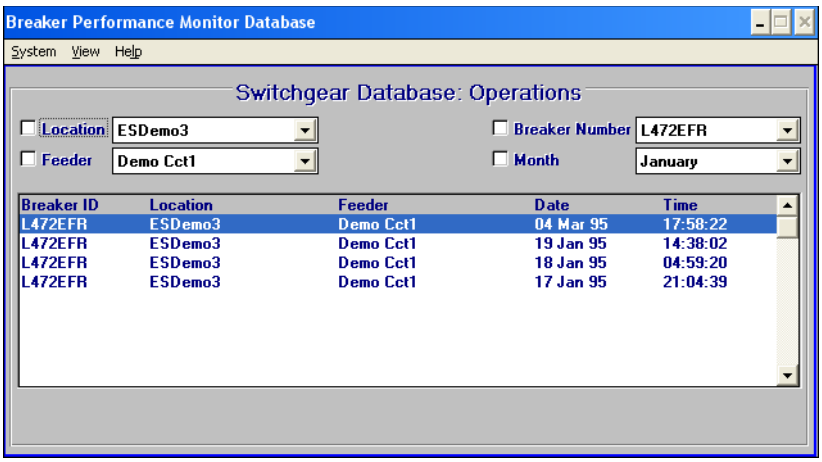

Figure A.49 Breaker Performance Monitor Main Window

There are three record views:

- Accumulated contact wear (default) -Lists the breaker number, the location of the breaker, the feeder it is on and the accumulated contact wear per phase (A, B and C).
- Total Current Interrupted
- Operations - Fills the list with circuit breaker operations records. For each record of each operation, the breaker number, the location of the breaker, and the feeder it is appears, along with the date and time at which the operation occurred.

Buttons and Fields

Location — Sorts the list by the location selected in the drop down.

Month	Sorts the list by month selected in the drop down. Available only for circuit breaker operations
Feeder	Sorts the list by feeder selected in the drop down.
Breaker number	Sorts by breaker number selected in the drop down.

Breakers with phase value greater than limit

Sorts the list according to phase values greater than the preset limit. This filters the Contact Wear list to only those breakers that have a total current value greater than the set threshold. Use this to check for switchgear needing maintenance.

Phase values above ?

Opens the Threshold dialog to input a threshold computed wear and operation values below which files do not appear. Use a percentage value, with the % symbol, and all records with a wear figures above this percentage of their set limits appear.

BPM Main Window Sorting Operations

Sort Record Lists

To sort the record list:

1. Click the check boxes, as required:
   - **Location**
   - **Feeder**
   - **Breaker Number**
   - **Month** - Operations only
   - **Breaker with phase values greater than limit** - deselects all other check boxes
2. Click **Phase values above ?**, if required, and the Threshold dialog appears (Figure A.50).

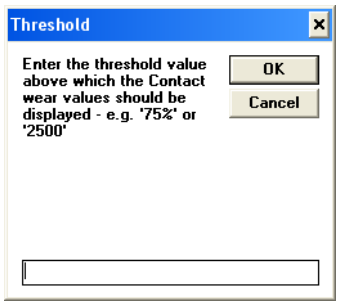

Figure A.50 BPM Threshold

3. Enter a value and click **OK**.

Operation Details

Use this window (Figure A.51) to:

- Display operations details
- Print details
- Edit operation details to see the results

This window initially appears only and the Edit button is enabled.

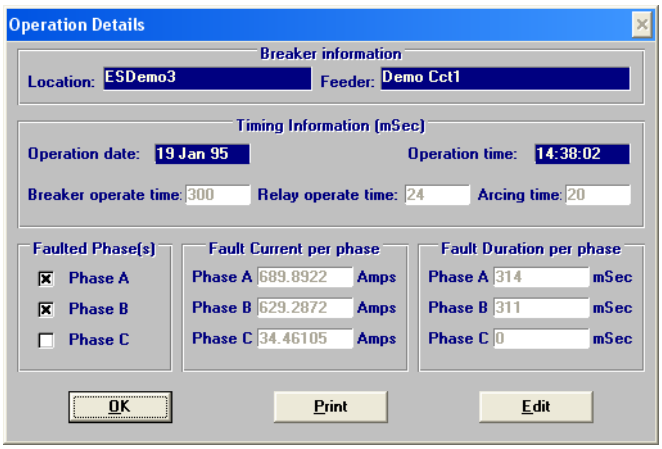

Figure A.51 Operation Details - View Mode

Buttons and Fields

Location	Displays the location.
Feeder	Displays the feeder.

Timing Information	
Operation date	Displays the operation date.
Operation time	Displays the operation time.
Breaker operate time	
	Displays the breaker operation time. Changeable in edit mode.
Relay operate time	Displays the relay operation time. Changeable in edit mode.
Arcing time	Displays the arcing time. Changeable in edit mode.
Faulted Phase(s)	Indicates the phases in fault. Changeable in edit mode.
Fault Current par phase	
	Displays the fault current per phase. Changeable in edit mode.
Fault Duration per phase	
	Displays the fault duration per phase. Changeable in edit mode.
Edit	Activates certain fields for editing so effects can be noted. Changeable in edit mode.
Print	Prints an image of the window to the default printer.

BPM Operation Details Operations

To display an operation details:

1. Select a specific record in the Operations window record list.
2. Double-click on the record or select a record and press *<Enter>*.

   The Operations Details window appears (Figure A.52) with the full details of the record in it.

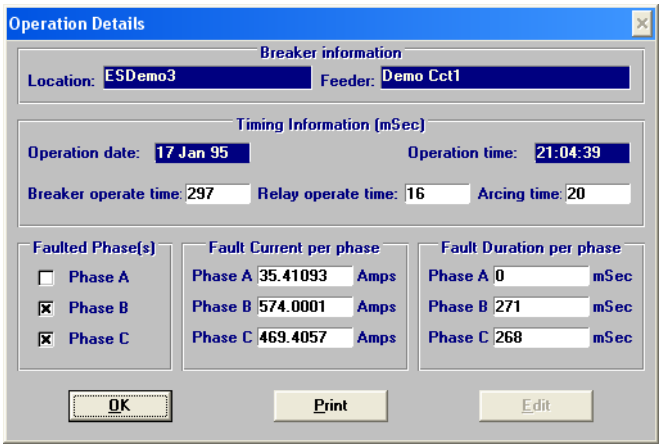

Figure A.52 Operation Details - Edit Mode

3. Click **Edit**.
4. Configure the active fields, as required.
5. Click **OK**.

The changes are reflected in the Operations window.

Set Service Date

Use this window (Figure A.53) to change the formula for calculating the contact wear or the service date of the breaker.

NOTE

Whenever the service date is changed, the accumulated contact wear is recalculated and only operations after that date are included.

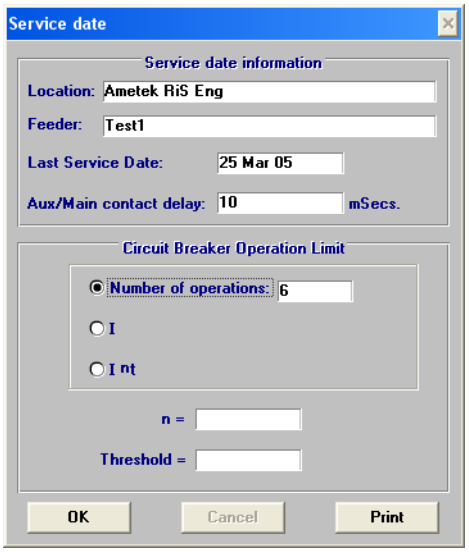

Figure A.53 Service Date

Buttons and Fields

Location/Feeder names

Enter the name for each.

Auxiliary/Main contact delay

Enter a time. Used as a way for determining an accurate time for the parting of the main contacts. This time (in milliseconds) is the difference in time from the sensed auxiliary contacts changing state until the main contacts open. This value can be negative as well as positive.

Last Service Date

Specify which breaker operations to included when calculating the maintenance time. All operations before this date are ignored. When a breaker is serviced, enter its service date.

Circuit Breaker Operation limit

Click a radio button to set the operation limit.

Breaker Performance Monitor (BPM) has three ways of determining the maintenance interval for switchgear. These are:

- Number of operations
- Accumulated current (current counter) (I)
- Dissipation function ($I^n t$)

The dissipation function has been promoted in recent years as a more accurate method of determining service life. The function $I^n t$ is used to estimate contact wear by measuring the energy in the arc as the contacts open. A value of n = 2 was the original guess but operation experience suggests that a value of 1.6 may be more accurate. The choice of maintenance interval measurement for each circuit breaker and the value of the power *n* are determined by operational experience and consultation with the manufacturer.

Number of Operations

Enter the threshold value for no. of operations mode.

n — Enter the value for n, the exponent in $I^n t$.

Threshold — Enter the threshold for the breaker.

BPM Service Date Operations

To configure:

1. Enter a *Location* name.
2. Enter an *Auxiliary/Main Contact Delay*.
3. Enter a *Last service date*.
4. Configure the *Circuit Breaker Operation Limit* by clicking either:
   - **Number of operations** and entering a value in the field.
   - **I**
   - **Int**
5. Enter *n*.
6. Enter a *Threshold*.
7. Click **OK**.

System Menu

This menu consists of:

- ″Set Edit Password″
- ″Archive″ on page A-69
- ″Print″ on page A-69

Set Edit Password

Use this window (Figure A.54) to set or change the password. The password protects unauthorized edits to the Operation Details including, the amount of wear for each breaker (no. of operations).

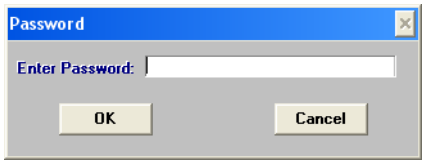

Figure A.54 Old Password

BPM Set Edit Password Operations

To set the password:

1. Select *System > Set edit password* and if there is an old password a dialog appears, click **OK**.
2. Enter a new password in *Enter Password*.
3. Click **OK** and the new Password dialog appears (Figure A.55).

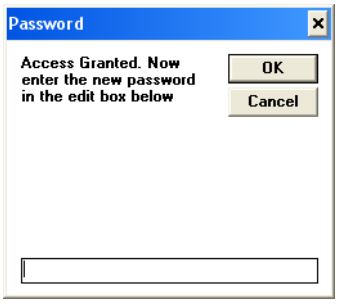

Figure A.55 New Password

4. Enter a new password and click **OK**.

Archive

Use this window (Figure A.56) to archive old records into another file to reduce searching and sorting times.

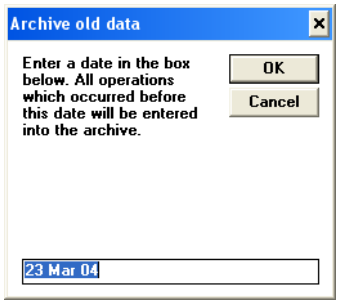

Figure A.56 Archive Old Data

BPM Archive Operations

To archive old data:

1. Select *System > Archive*.
2. Enter the date before which all data is archived in the format *dd mmm yy*. For example, 21 Apr 04.

NOTE

Ensure that the specified date is before any currently specified service dates.

3. Click **OK** and a Save as dialog appears.
4. Enter a file name and directory for the archived data and click **Open**. The default file is *archive.mdb* in the *c:\bpm* directory.

Print

See "Print/Print Preview/Print Setup" on page 3-37.

View Menu

This menu consists only of Operations and Contact Wear.

Operations/Contact Wear

BPM can display either circuit breaker operations, recorded by the Ametek recorder, the total current interrupted or the accumulated contact wear on the breakers due to the operations.

To change between these views:

- Select *View > Operations* or *View > Contact Wear*.

Help Menu

See "Help Topics" on page 3-115.

Fault Classifier Tutorial

This tutorial helps you get the Expert System Fault Classifier up and running. The various steps involved assist you in setting up the Substation Configuration File for one of the demonstration fault records included with this system. You will:

- Classify this fault record
- Analyze the RMS plots associated with the record and,
- View the explanation for the fault.

It is useful to run the Expert System along side this tutorial and follow each step as instructed.

NOTE

The following steps assume that the Expert System is already installed to the same directory as Display Station and that Display Station is running.

Step-by-Step Guide

1. Select the *ESDemo3* from the Display Station main window and double-click it. This record details window appears.
2. Click **Analyze**. This runs Display Station Analysis for this fault record.

   The sinusoidal waveforms recorded for this fault appear.
3. Select *Tools* > *Expert System* on the DSA menu and the **Fau**lt Classifier is initiated

NOTE

If *Expert System* is not on the *Tools* menu, it has not been installed correctly.

If this is the first time that the **Fault Classifier** is run, then the Substation Configuration File is probably not set up for the demo recorder *ESDemo3*. In this case, a message appears indicating this. Click **OK** to continue.

The Fault Classifier main window appears.

The next few steps involve setting up the Substation Configuration File and classifying the fault.

4. Click **Edit/Create Substation Configuration File** at the bottom of the main window to enter details specific to the recorder *ESDemo3*. The text box at the top of the Substation Details window lists the substation or recorder name.
5. Enter the following details to set up the demo location:
   - Enter a name for the circuit. e.g. *Demo Cct.*
   - Select *Phase Group 1* for the voltage phase group.
   - Select *Phase Group 2* for the current phase group.
   - Select the Relay Channel option and choose *5 RT8 AIP*
   - Select the C/B Channel option and choose *6 RT8 C/B Contact*

   Time limits and thresholds can also be entered for the relay and circuit breaker digital channels.
6. Click **Neutrals** and enter the neutral channel information. On the Neutral Inputs window:
   a. Click the *Neutral inputs* check box and choose *NONE* for Voltage and *8 In* for Current.
   b. Click **Return**

   This is enough information to allow the Fault Classifier to perform a classification on the fault.
7. Click **Close** and click **Yes** to save the details for the recorder. The main window reappears.

NOTE

These details are saved for future use and any other records returned from this recorder will use the same details. These are all changeable.

8. Classify the fault by selecting *Expert > Classify Fault* in main window. After a few seconds the fault conclusion appears in the two list boxes.
9. Display the RMS plots of the eight analogue inputs by:
   a. Select *Expert > Graph Plots*.
   b. Click the leftmost button on the toolbar of the *RMS Graphs* window.
   c. Select channel numbers from the list or a complete phase group and click **OK**.

   Displaying the RMS graphs is a way of verifying the conclusion drawn by the fault classifier.

Appendix B. 3Com 56k LAN Modem Configuration: Manual and Autopolling

The recording instruments used with Display Station (TR2000, TR100+, TR100, PQR, etc.) can be connected via an RS232 serial link, a dial up modem or a TCP/IP network connection over a LAN or WAN. All instruments have a serial connection and most have either a modem or network card or both.

Display Station can also support a dial-up network where a connection is made via a modem to a network (Figure B.1). For this, use the Windows Dial-Up Connections. For each remote network a dial-up configuration must be created. For information on this see Appendix C "DS32 3Com/Remote TR 3Com LAN Modem Connection Configuration (Autocall)". To support auto-call an Incoming Connection must also be created. For information on configuring auto-call from a network or pseudo machine, see Appendix C "DS32 3Com/Remote TR 3Com LAN Modem Connection Configuration (Autocall)".

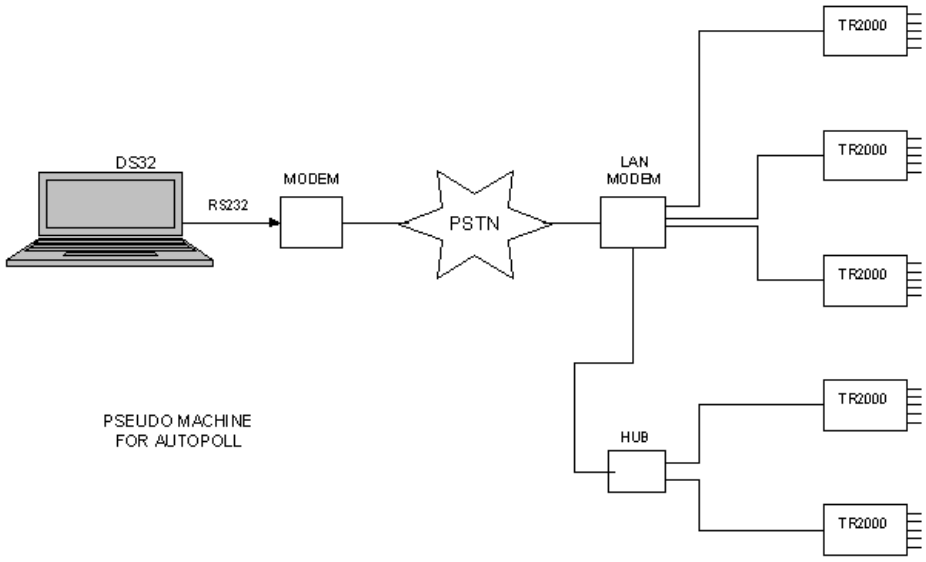

Figure B.1 Dial-Up Networking Via Modem on Network

You can create a pseudo machine (PM) from a number of individual recorders connected via a standard network. If adding an individual recorder accessed via a modem, then use dial-up networking to connect to a PM. To create a small dial up network, a product like the 3Com OfficeConnect 56k LAN modem may be used. This allows both dial in and dial out functions to support auto-poll and auto-call. The configuration of this product for use with Display Station is given in this appendix and Appendix C ″DS32 3Com/Remote TR 3Com LAN Modem Connection Configuration (Autocall)″.

For more complete information about configuring the 3Com LAN modem, use the help at the bottom of each configuration page or the user manual which is available as *uguide.pdf* or *uguide.hml* file on the DOCS directory of the CD that was supplied with the product.

NOTE

Remote recorder networks may operate independently of a company LAN/WAN or intranet. If, however, the connections are part of a larger network the network administrator or IT department should be involved in the issuing of IP addresses and configuration of the system.

To create a remote dial up network of recorders each instrument must be fitted with a network card (NIC). These are all connected directly to the LAN modem. This device accepts up to four recorders directly. To extend this an extra hub unit may be added. Up to twenty-three recorders can be accommodated on one LAN modem.

The configuration of the system is divided into these parts:

- ″Set Up the DS32 Computer 3Com Modem to Transient Recorder 3Com Remote Station″
- ″Set up the DS32 Master Station for Use with the Async Modem″ on page B-15
- ″Set Up the First Remote Sub-station 3Com LAN Modem″ on page B-17
- ″Set Up the First Remote Transient Recorder″ on page B-29
- ″Set Up the Second Remote Transient Recorder″ on page B-30

Set Up the DS32 Computer 3Com Modem to Transient Recorder 3Com Remote Station

For each recorder the IP address, subnet mask and router IP address are all required. If auto-call is required see Appendix C "DS32 3Com/Remote TR 3Com LAN Modem Connection Configuration (Autocall)". If the recorders or Display Station are connected to a corporate network the network administrator must issue these addresses. Obey the following rules:

- If the system is running stand alone the default address range is *192.168.1.xxx*, where *xxx* ranges from 3 to 254.
- Do not use *192.168.1.1*, since this is the default address of the LAN modem itself.
- Do not use *192.168.1.2*, since it is used as the default address for the PC linked to the LAN modem for configuration.
- The subnet mask should be *255.255.255.224*.
- The router IP must be set to the address of the LAN modem. The default value of this is *192.168.1.1*.

Windows 2000 Configuration

This section explains how to bond the Master Station async modem to call a remote 3Com LAN modem for Windows 2000.

The first windows contain the setup information for the DS32 computer. This setup allows the PC system to communicate using TCP/IP via a modem to the remote 3 Com LAN modem. Figure B.2 is an example from a Windows 2000 operating system. See "Windows XP Configuration" on page B-8 for an example of Windows XP configuration.

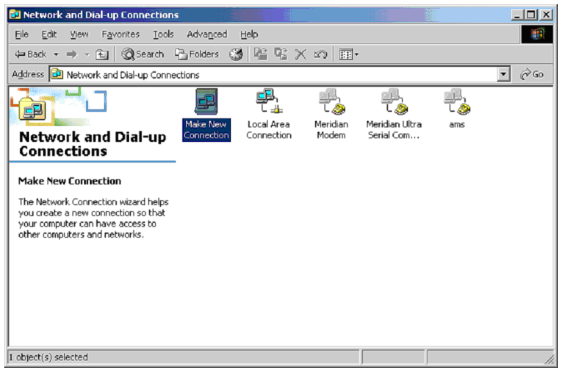

Figure B.2 Network and Dial-up Connections

To perform this procedure:

1. Click **Make a New Connection** to start the setup wizard (Figure B.3).

Figure B.3 Network Connection Wizard

2. Click **Next** and Figure B.4 appears.

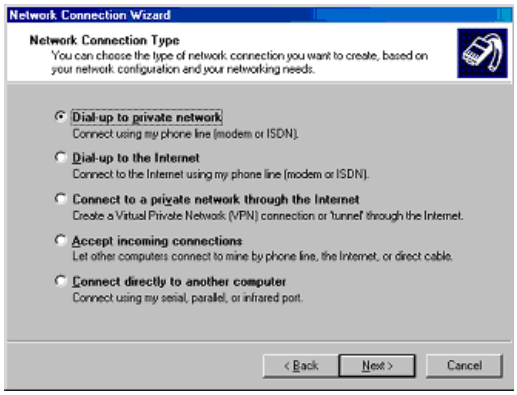

Figure B.4 Network Connection Type

3. Click **Dial-up to a Private Network** and click **Next** and Figure B.5 appears. If you have more than one modem, you are prompted to choose which modem to use.

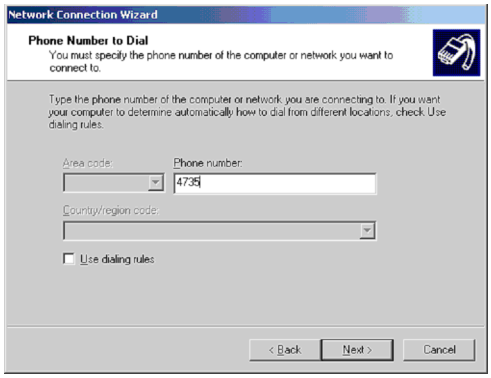

Figure B.5 Phone Number To Dial

4. Enter the phone number of the remote sub-station 3Com LAN modem in *Phone number to Dial*, click **Next** and Figure B.6 appears.

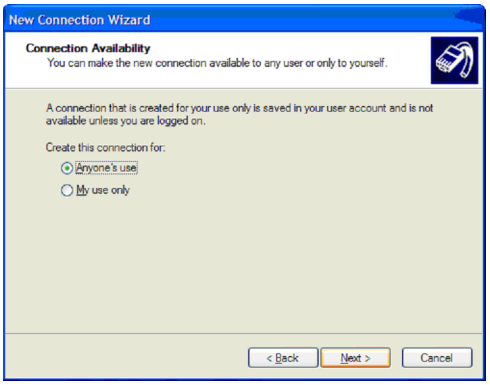

Figure B.6 Connection Availability

5. Click **For all Users** and click **Next** and Figure B.7 appears.

Figure B.7 Sub-Station Name

6. Enter a name. The name and password you choose must be the same as what you set up in the 3Com LAN modem. The *Name* and *Password* are case sensitive. To make the setup less confusing and reduce the chance of a setup mistake, keep everything in the same case.

   We have named the first sub-station AMS1. This is in capital letters, but you can use numbers also. Do not add a shortcut to your desktop, as it is not needed.

7. Click **Next** and Figure B.8 appears.

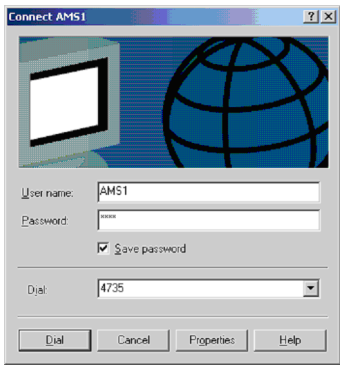

Figure B.8 Name and Password

8. Enter the password, ensuring it is all upper or lower case, click **Save Password** and enter the entire phone number of the sub-station to call. If you need a 9 or some other number to dial out, make sure to include it.

9. Click **Properties** and Figure B.9 appears.

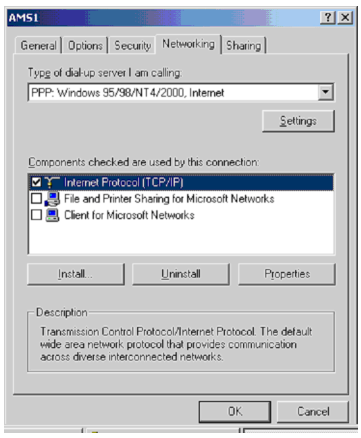

Figure B.9 Networking Tab

10. Click **Internet Protocol (TCP/IP)**. Ensure that type of dial-up server in Figure B.9 matches your setup.

11. Click **Properties** and Figure B.10 appears.

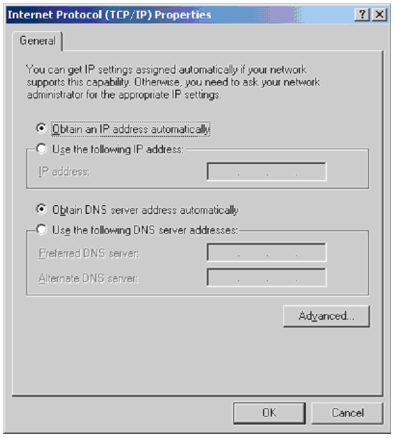

Figure B.10 TCP/IP Properties

12. Click **Obtain an IP Address automatically** and **Obtain a DNS server address automatically** and click **OK**.

This procedure has generated a Dial Up Networking shortcut that can be selected under DS32. See "Recorder Network" on page 2-32 for more details.

Windows XP Configuration

This procedure is an example of how to bond your Windows XP async modem to TCP/IP. It creates a DS32 PC Async modem capable of calling a remote 3Com LAN modem at a sub-station.

To perform this procedure:

1. Click **Start** and select *Connect To* and select *Show all connections* from the pop up (Figure B.11).

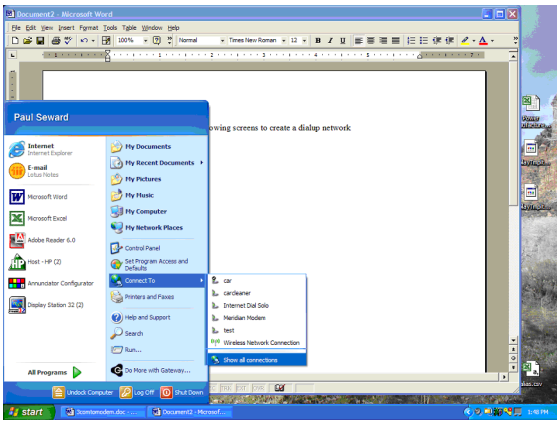

Figure B.11 Connect To

The *Network Connections* window appears (Figure B.12).

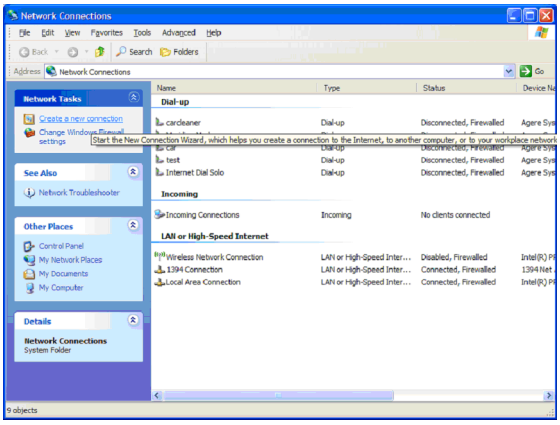

Figure B.12 Network Connections

2. Click **Create a new connection** in the upper left hand corner.

   The *Welcome to the New Connection Wizard* window appears (Figure B.13).

Figure B.13 Welcome to the new Connection Wizard

3. Click **Next** and Figure B.14 appears.

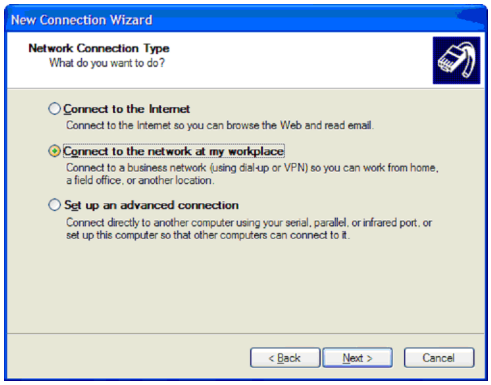

Figure B.14 New Connection Type

4. Click **Connect to the network at my workplace,** click **Next** and Figure B.15 appears.

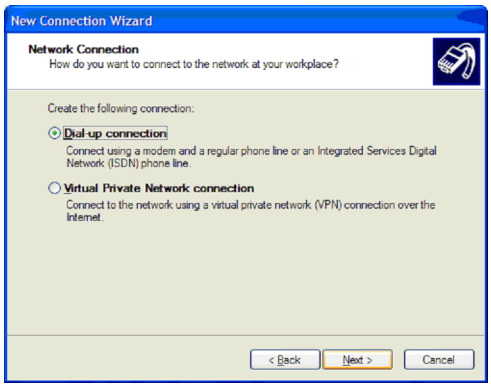

Figure B.15 New Connection

5. Click **Dial up connection**, click **Next** and Figure B.16 appears.

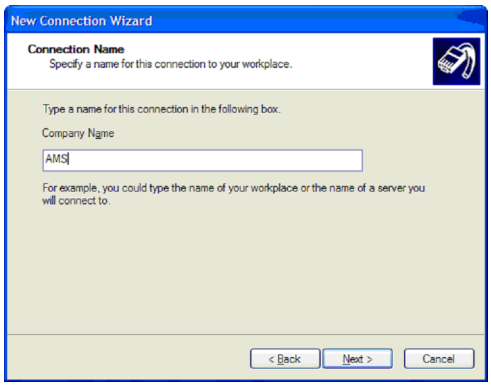

Figure B.16 Connection Name

The *Company Name* and *Password*, must match the name and password in the 3Com LAN modem device exactly. We have used AMS, but we could use AMS1 or AMS2, etc.

6. Enter the name, the case must match exactly, click **Next** and Figure B.17 appears.

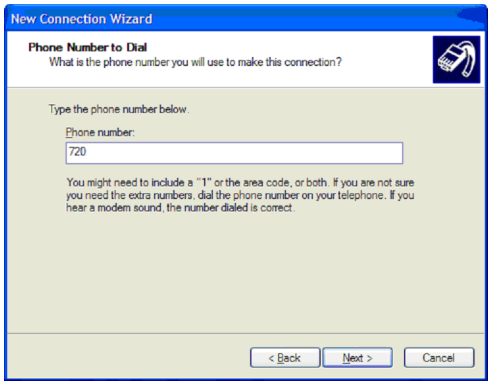

Figure B.17 Phone Number to Dial

7. Enter the *Phone number* of the sub-station where the 3Com LAN modem and transient recorders are located, click **Next** and Figure B.18 appears.

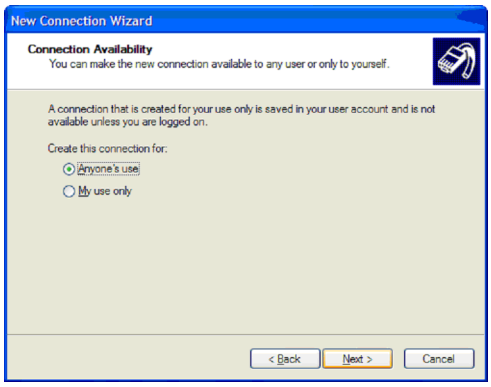

Figure B.18 Connection Availability

8. Click **Anyone's use**, click **Next** and Figure B.19 appears.

Figure B.19 Complete the Connection

9. Click **Finish** and Figure B.20. Do not add a shortcut to your desktop, as it is not needed. This new connection is selected for the correct Location under DS32, Edit – Recorder Network. If needed, this connection can also be used for troubleshooting the connection.

   Remember, the user name and password must match the information in the 3Com exactly.

10. Click **Save password** and then click **Properties** (Figure B.20). If the user name or password do not match the remote 3Com LAN modem exactly you can connect this modem to 3Com LAN modem, but no data is transferred. You could also click **Me only** or **Anyone that uses this computer** depending on how your PC is used.

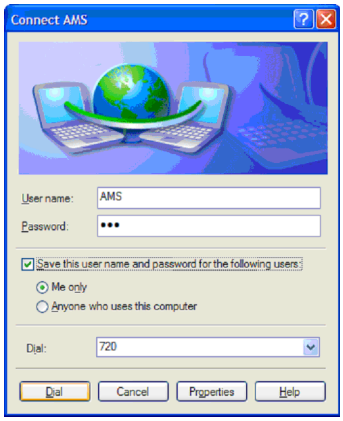

Figure B.20 Connect AMS

11. Click **Properties** and Figure B.21 appears.

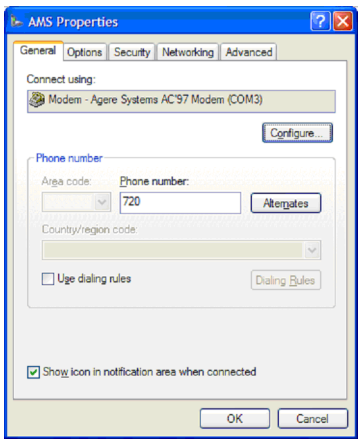

Figure B.21 AMS Properties

12. Select the desired modem and then click the **Networking** tab (Figure B.22).

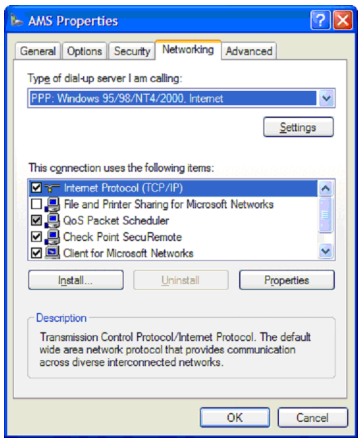

Figure B.22 AMS Networking Tab

13. Select *PPP: Windows 95/98/NT4/2000*, click **Internet protocol (TCP/IP)**, click **Properties** and Figure B.23 appears.

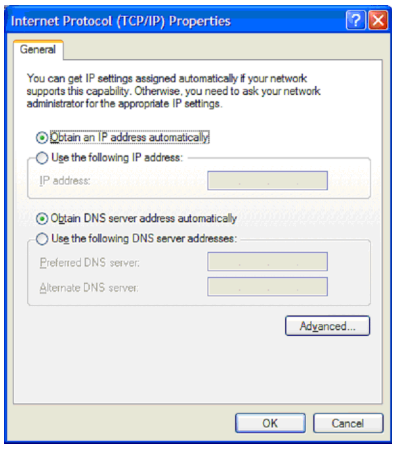

Figure B.23 XP TCP/IP Properties

14. Click **Obtain an IP address automatically** and **Obtain DNS sever address automatically,** click **OK** and Figure B.22 reappears.

15. Click **OK** and setup is complete. The dial up network is now complete for this sub-station only. You need to generate one of these for each remote sub-station you plan on calling that has a 3Com LAN modem. If you wish to change the name or password, then that 3Com LAN modem must be set up with the exact same information. If the information is incorrect, you will be unable to completely connect to the LAN modem and transfer data.

Set up the DS32 Master Station for Use with the Async Modem

This section explains how to select and add the correct modem connection for each recorder.

To setup in DS32 for the remote sub-station:

1. Open DS32 and select *Edit > Recorder Network* (Figure B.24).

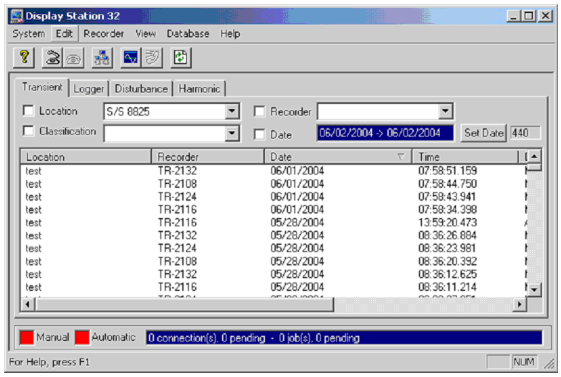

Figure B.24 DS32 Transient Tab

The *Recorder Network – Edit* window appears (Figure B.25).

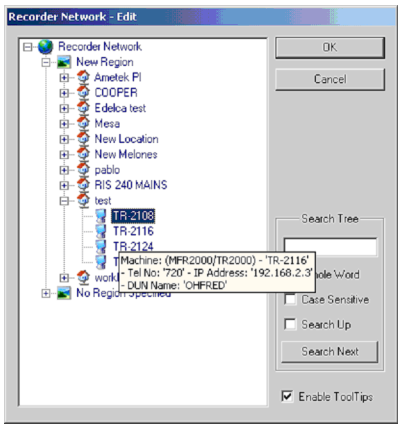

Figure B.25 Recorder Network - Edit

Under *Recorder Network* you can have multiple Regions. For example, you could have a North, South, East, and West Region. Or you could have a region broken down into Counties. If it's not a concern or you only have a few recorders, you can just use the Default *New Region* and place all of your locations under that.

2. Add a new Location by right-clicking on the Region and selecting *Add new Location*. The Location is basically the name of the sub-station or sub-station area.
3. Add recorders under the Location by right-clicking on the Location and selecting *Add recorder*.

   As you add the Locations and recorders, you can right click on each one of them and select *Rename location* or *Rename recorder* to change each name. Once you have added your Location and the transient recorders under it, you are ready to add the details of the recorder. Make sure that the recorder type is correct, as the default is a PQ&R type recorder.
4. Ensure you select a TR2100, TR100 plus, etc., then (Figure B.26):
   a. Click the **TCP/IP** tab
   b. Click the **TCP/IP** radio button
   c. Enter the *Recorders IP address*
   d. Select the correct *Dial-Up Networking* connection that you have already created.
   e. Click **OK** and you are done with setting up Display Station for this one recorder. Repeat this for each recorder out in the field.

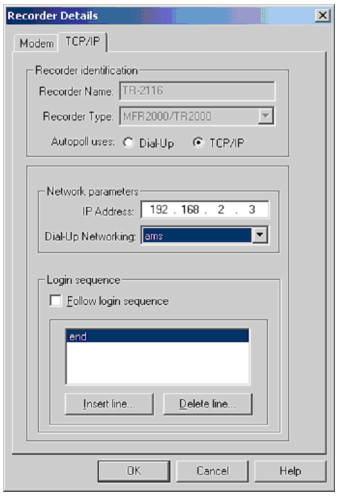

Figure B.26 XP Recorder Details

Set Up the First Remote Sub-station 3Com LAN Modem

This procedure sets up the 3Com device at the sub-station that is separate from the DS32 PC with the async modem setup.

To perform this procedure:

1. Set up the computer that you plan to use to configure the 3Com device:

    a. Double-click the **Networking dialup connections** icon (Figure B.27).

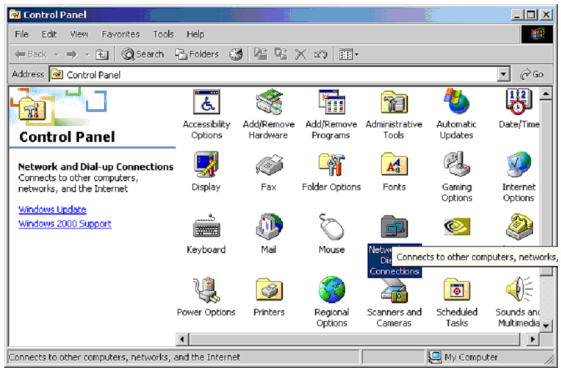

Figure B.27 Networking Dialup Connections Icon

    b. Double-click the **Local Area connection** icon (Figure B.28).

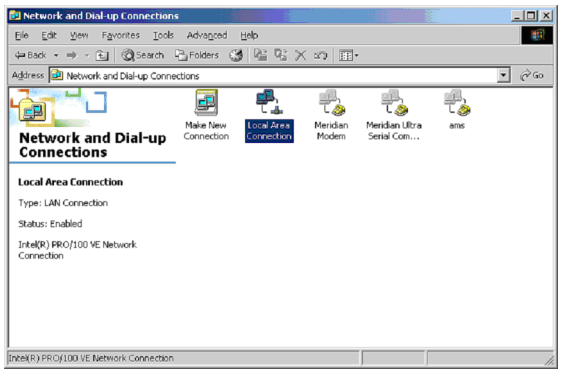

Figure B.28 Local Area Connection Icon

The *Local Area Connection Status* window appears (Figure B.29).

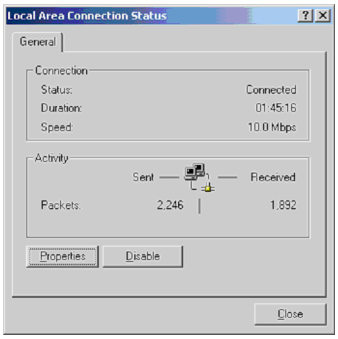

Figure B.29 Local Area Connection Status

c. Click **Properties** and Figure B.29 appears.

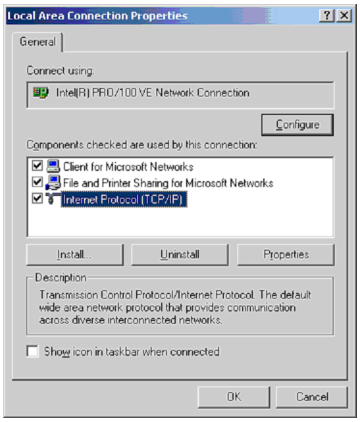

Figure B.30 Local Area Connection Properties

d. Click **Internet Protocol (TCP/IP)** and then click **Properties** and Figure B.31 appears.

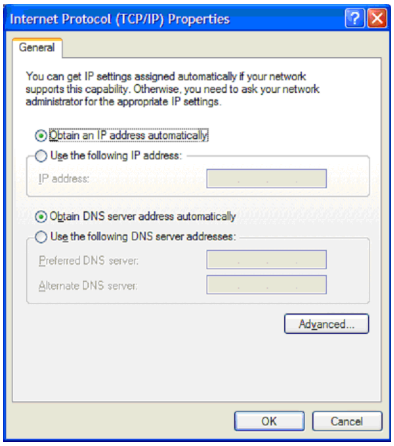

Figure B.31 Internet Protocol (TCP/IP) Properties

2. Click **Obtain an IP address automatically** and **Obtain DNS server address automatically** and click **OK**.

   The PC is now ready to communicate to the 3Com LAN modem that is hooked up to the Transient Recorders at the sub-station. Windows Internet Explorer is used for all communications to the 3Com LAN modem. The next procedure guides you through that.

To set up the remote sub-station 3Com LAN modem:

1. Press the reset button located on the back of the 3Com device and hold it. While you hold it, the alert light must goes through three sets of flashing. This takes around 30 seconds minimum. This sets the 3Com LAN modem device to the factory default settings.
2. Reboot the computer if you are using Windows 2000 and open Window's Internet Explorer. Normally you do not need to reboot Windows XP in this case. Once you open Window's Internet Explorer, Figure B.32 appears.

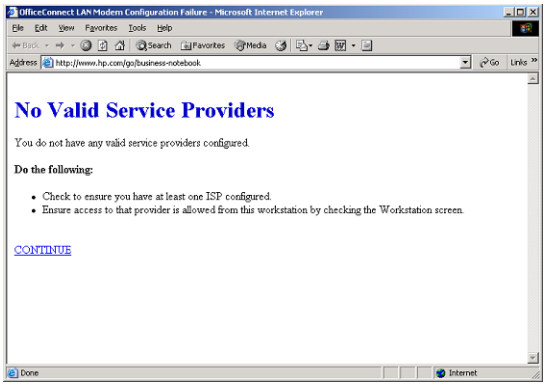

Figure B.32 No Valid Service Providers

3. Click **Continue** and Figure B.33 appears.

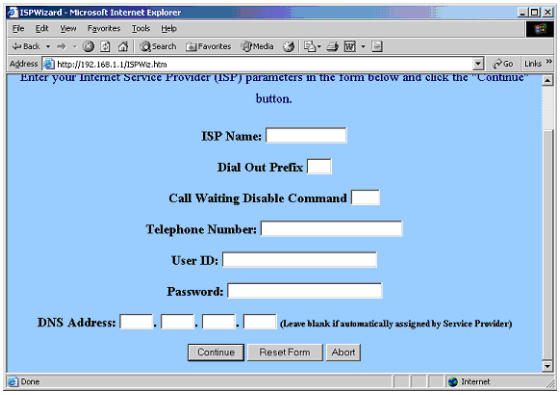

Figure B.33 ISP Wizard

4. Click **Abort** and Figure B.34 appears.

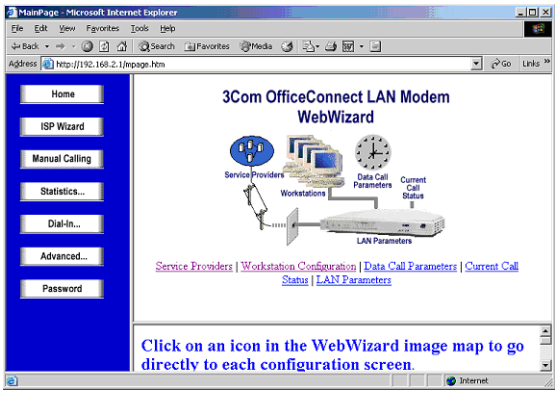

Figure B.34 3Com LAN Modem Wizard

5. Click **Dial-In** and Figure B.35 appears.

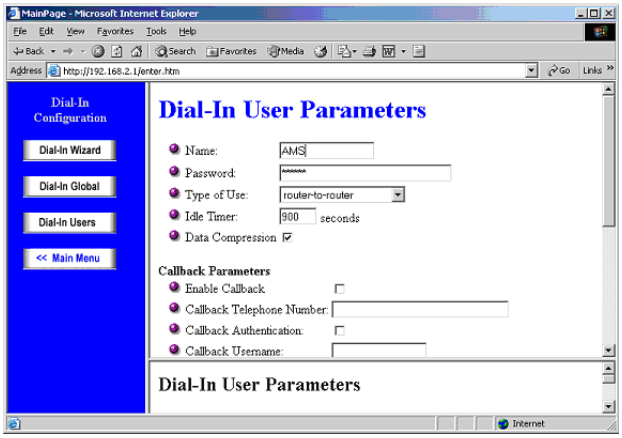

Figure B.35 3Com Dial-In User Parameters

6. Configure this window as follows:

- The name and password must match the setup from what you entered on the *Network Connection Wizard* window.
- Set all of the following pages with the correct IP addresses for your application.
- The name and password must match the case you entered in the Setup Wizard.
- *Router to Router* must be selected, and *Data Compression* must be checked.
- The *Idle Timer* is set high, that the modem does not hang up if it sees a break in data transfer.

7. Scroll down and set the following parameters (Figure B.36):

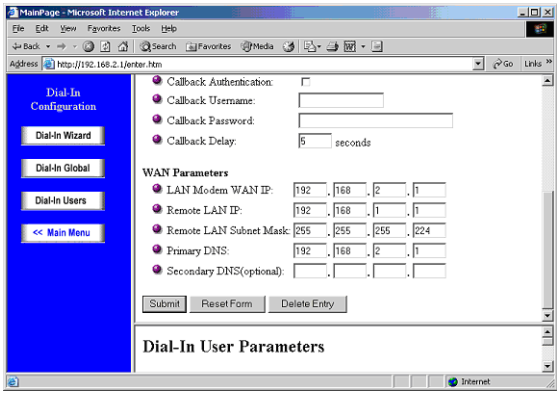

Figure B.36 3Com WAN Parameters

- *LAN Modem WAN IP:* This is the remote sub-station's 3Com's LAN modem's IP address. This is normally the first sub-station that you set up. The second sub-station LAN modem's address is normally *192.168.3.1*, etc.
- *Remote Lan IP*: This is the IP address (by default) of the PC running DS32 (by way of DHCP).
- *Remote Lan IP Subnet Mask*: This is the default Subnet mask and should be used for all 3Com LAN modems or devices talking to them. If you do not use this mask and attempt to go beyond the limit of the 3Com device, the 3Com device will not work.
- *Primary DNS*: This is the same IP address as the *Remote LAN IP address*.

8. Click **Submit**.

NOTE

Always click Submit before changing screens.

9. Click **Dial-In Global** and Figure B.37 appears.

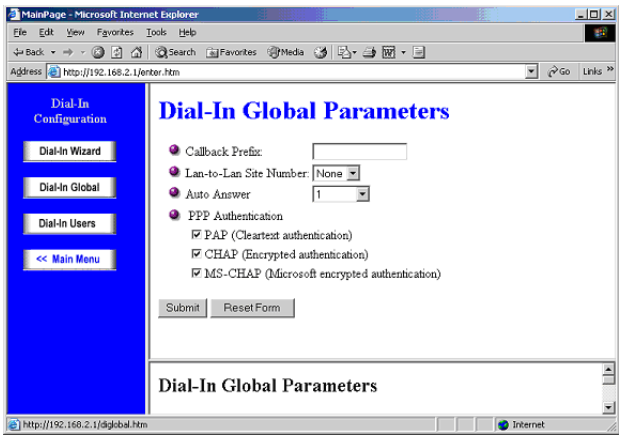

Figure B.37 3Com Global Parameters

10. Configure *Dial-In Global Parameters:*

- Change *Auto Answer* to the *1*
- Click the check boxes for *PAP, CHAP* and *MS-CHAP.*
- Click **Submit**

11. Click **Service Providers** from the main window and Figure B.38 appears.

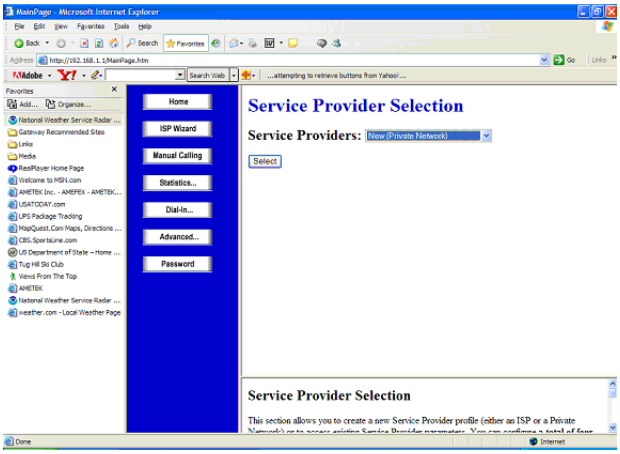

Figure B.38 3Com Service Provider Selection

12. Click **New (Private Network)** and click **Select** and Figure B.39 appears.

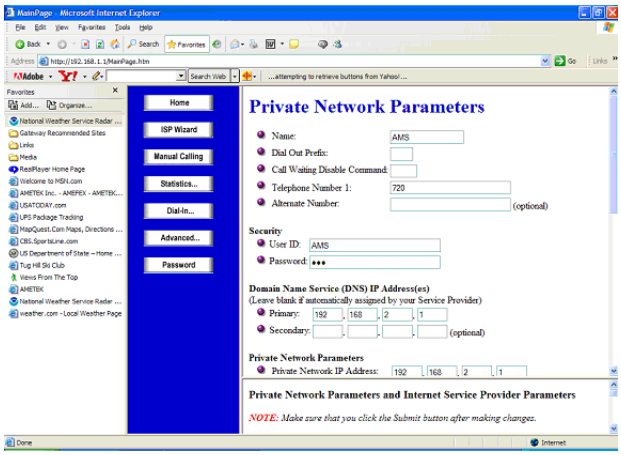

Figure B.39 Private Network Parameters

13. Enter the:

a. *Name* that calls in. In our previous examples we used AMS and/or AMS1 as a default name for all locations. In our example, we are only using one user name and password at the PC and at the 3Com LAN modems, but this does not have to be the case.

b. *Telephone number* if you have another 3Com LAN modem at the PC running DS32. This phone number is used for Autocalling only, and is not used if you are only using a 3Com LAN modem at the remote sub-station locations.

c. *User ID* and *Password* that you entered under the *Network Connection Wizard*.

14. Scroll down and configure the *DNS parameters* (Figure B.40):

a. Enter the *Domain Name Service IP address*. This is by default *192.168.1.1*.

b. The *Private Network Parameters* are the same with the default Subnet Mask.

c. Increase the *Callback Delay* to at least 5 and the *Callback Timeout* to around 90.

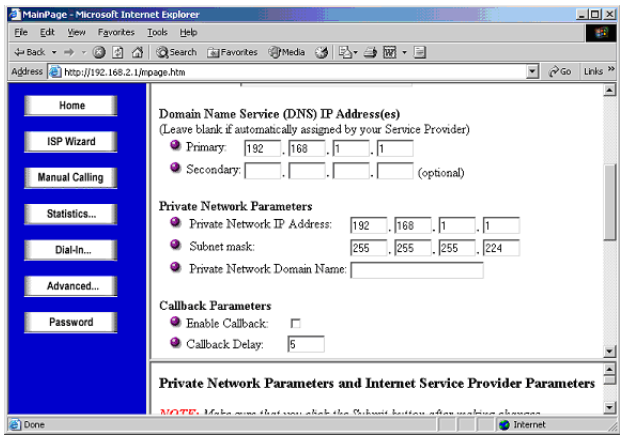

Figure B.40 Private Network DNS Parameters I

15. Scroll down and configure the *Miscellaneous Parameters* (Figure B.41 and Figure B.42):

a. *IP address of the Remote* sub-station 3Com LAN modem that you are currently setting up.

b. The Subnet Mask is always left untouched.

c. The *Default Workstation* is the PC that is setting up the attached 3Com LAN modem.

d. Enable the intelligent NAT by clicking **Yes**.

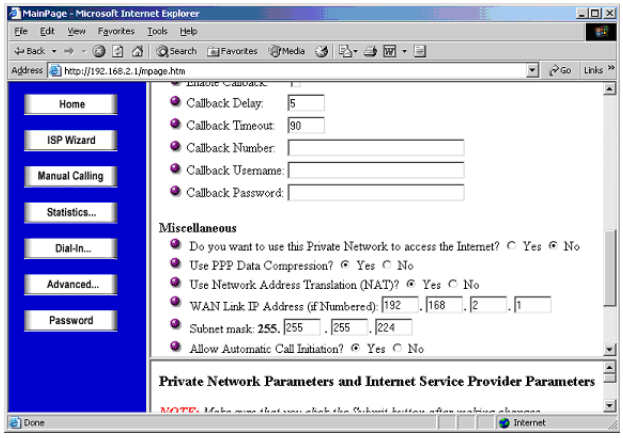

Figure B.41 Private Network DNS Misc. Parameters I

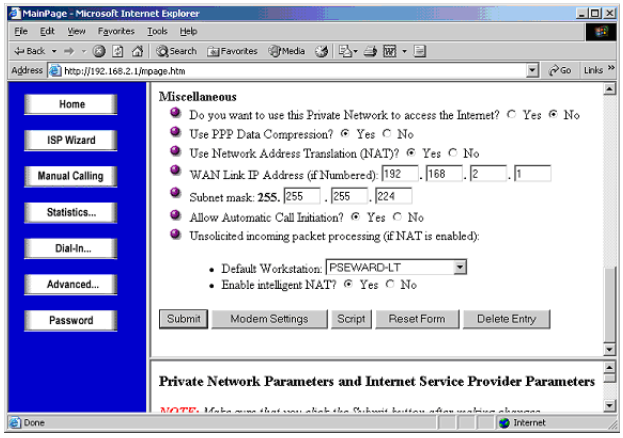

Figure B.42 Private Network DNS Misc. Parameters II

16. Click **Submit** and the *3Com OfficeConnect Lan Modem Web Wizard* window reappears (Figure B.34 on page B-21).

17. Click **Workstation Config** and Figure B.43 appears.

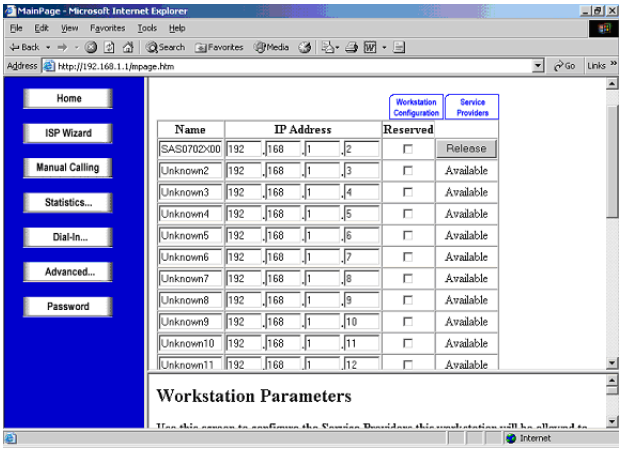

Figure B.43 3Com Workstation Parameters

18. Reserve the static *IP Addresses* for the recorders and the PC that connects to it for future changes:

- *192.168.2.2* is the PC's IP address that is currently connected to it. This is handed out by default by DHCP to the PC.
- *192.168.2.3* is the IP address of the first recorder attached.
- *192.168.2.4* is the second recorder.

Only the recorder's IP address need to reserved.

19. Click **Submit**.

The main 3Com LAN Modem default window reappears (Figure B.34 on page B-21).

20. Click **Data Call Parameters** and Figure B.44 appears. Enter parameters as in Figure B.44.

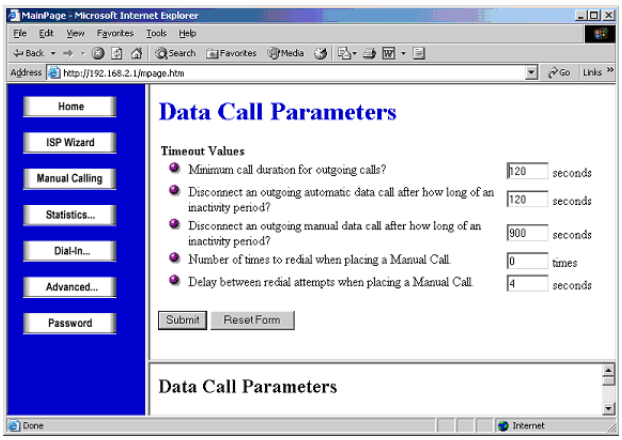

Figure B.44 3Com Data Call Parameters

For *Disconnect an outgoing automatic data call after how long of an inactivity period*, we have set a value of 900 seconds. In some cases this may be too long of a value and can be reduced if needed.

21. Click **Submit** and the main window reappears (Figure B.34 on page B-21).

22. Click **LAN Parameters** and Figure B.45 appears.

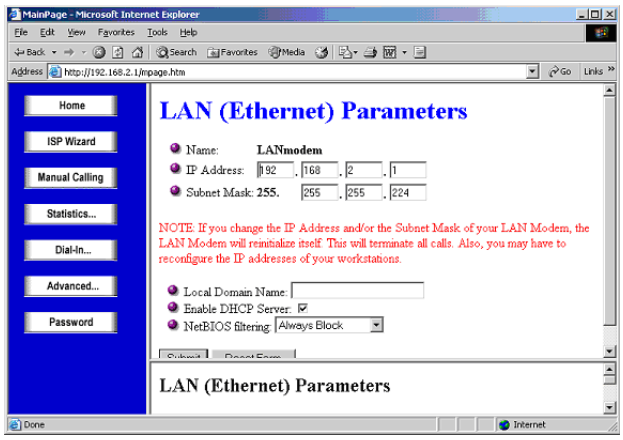

Figure B.45 3Com LAN (Ethernet) Parameters

Configure this screen:

- Change the *IP Address* to the one that you plan on using for this sub-station. As always, enter the default Subnet Mask. To avoid setup problems, for the:
  - First sub-station you would normally use *192.168.2.1*.
  - Second sub-station you would use *192.168.3.1*, and follow this pattern for the rest.

When you change the LAN parameters IP or Sub Mask, it may be necessary to reboot your computer to communicate to the 3Com. As this will most likely put you on a different LAN, DHCP needs to issue a new IP address for your PC.

Set Up the First Remote Transient Recorder

This procedure sets up sub-station A's transient recorder #1's IP address, Subnet Mask, and Router's address, using DS32.

To perform this procedure:

1. Open DS32 and connect to the first transient recorder using the direct connect option and the RS232 direct connect cable.
2. Navigate to the *Recorder Configuration* window (Figure B.46).

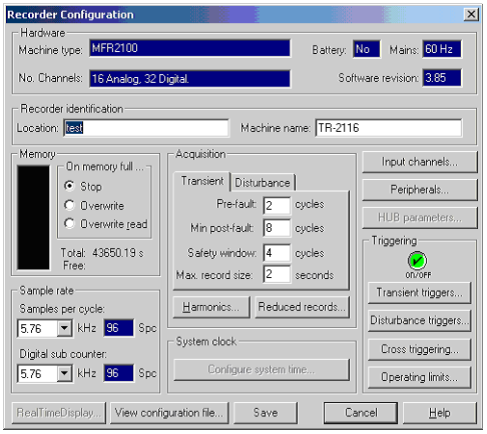

Figure B.46 3Com Recorder Configuration

3. Click **Peripherals** and Figure B.47 appears.

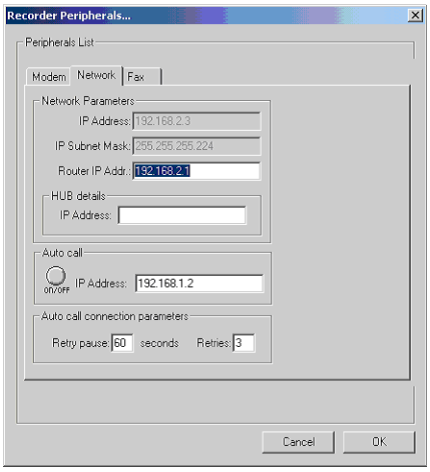

Figure B.47 3Com Recorder Peripherals

4. Enter the *IP Address* for that recorder. The default IP Subnet Mask always remains the same.
5. Enter the *Router IP Addr,* the IP address of the router to which the transient recorder attaches.
6. Click **OK** and click **Setup**. You can now disconnect from this unit and proceed to the next unit.

Set Up the Second Remote Transient Recorder

To perform this procedure:

1. Move the RS232 cable to the next transient recorder and connect to it using DS32 and the direct connect option with the RS232 direct connect cable.
2. Navigate to the *Recorder Configuration* window (Figure B.48).

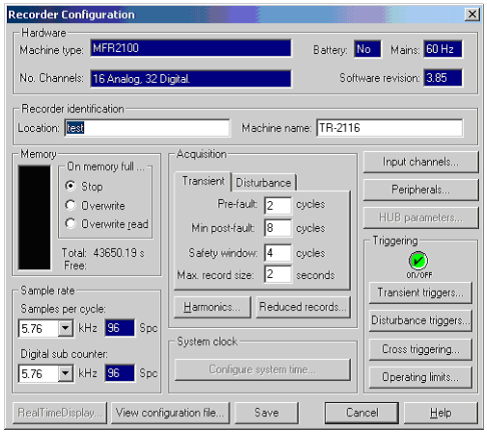

Figure B.48 3Com Recorder Configuration

3. Click **Peripherals** and Figure B.49 appears.

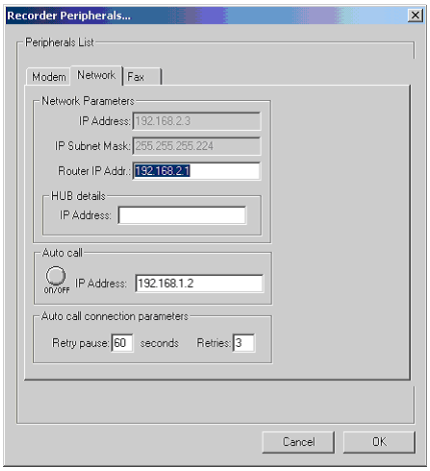

Figure B.49 3Com Recorder Peripherals

4. Enter the *IP Address* for that recorder. The default IP Subnet Mask always remains the same.
5. Enter the *Router IP Addr,* the IP address of the router to which the transient recorder attaches.
6. Click **OK** and click **Setup**. You can now disconnect from this unit and proceed to the next unit.

Appendix C. DS32 3Com/Remote TR 3Com LAN Modem Connection Configuration (Autocall)

The pseudo machine configuration (Figure C.1) uses either a LAN/WAN or dial-up network to make a remote connection. Both configurations support manual connections and auto-poll. The LAN/WAN scheme also supports auto-call where the recorder initiates the connection. If auto-call from a pseudo machine is required for a dial-up network connection, a different configuration is required. This prevents Windows from assigning a default gateway for a dial-in connection, making it impossible for the PC to communicate with a remote instrument through a LAN modem.

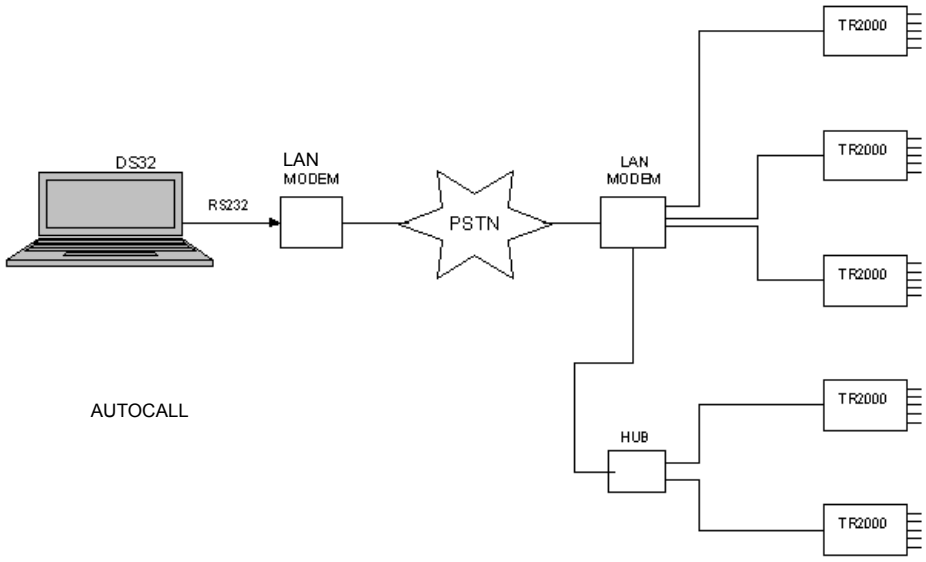

Figure C.1 Pseudo Machine Configuration

To implement a scheme that supports an auto-call from a pseudo machine, there must be a 3Com-to-3Com card connection. Then connect the PC to the LAN modem via a LAN connection. The operating system provides a network connection and the local LAN modem provides the dial-in services. The dial-out services in the LAN modem are very limited, so a standard modem connection is used to provide these.

The LAN modem uses a PC with a network connection and web browser (e.g. Windows Explorer) to configure the connection. This requires that the PC be set to support dynamic IP addresses (DHCP).

To configure the system to support manual connection, auto-poll and auto-call there several area that must be configured:

- ″Set Up the Recorders″
- ″Setup a 3Com Device Connected to the DS32 Computer″ on page C-3
- ″Setup the DS32 Computer's Network "NIC" Card.″ on page C-14
- ″Set Up the First Remote Sub-station 3Com LAN Modem″ on page C-17
- ″Set Up the DS32 Transient Recorders for Autocall″ on page C-31

The network IP address of each recorder must be unique as the recorders do not support DHCP.

Set Up the Recorders

Obey the following rules:

- For each recorder the IP address, subnet mask, auto-call IP address and router IP address are required.
- If the recorders or Display Station are connected to a corporate network, the network administrator must issue these addresses.
- If the system is running stand alone the default address range is *192.168.yyy.xxx*, where *xxx* ranges from 3 to 31. Do not use the address *192.168.yyy.1* since this is the default address of the LAN modem itself.
- Do not use *192.168.yyy.2* since it is used as the default address for the PC linked to the LAN modem for configuration.
- The subnet mask should be *255.255.255.224*.
- Start the value yyy at 1 for the first site and increase up to 253. Site 254 is reserved for Display Station. This scheme allows up to 29 recorders at up to 253 separate sites. For other IP address and subnet configurations please consult your network administrator.
- The router IP must be set to the address of the local LAN modem. The default value of this is *192.168.yyy.1*. For auto-call, the IP address must be the same as the one defined for the PC running Display Station. The Auto-call On/Off button must be on (colored green).

Setup a 3Com Device Connected to the DS32 Computer

This procedure sets up a 3Com device connected to the DS32 computer. A standard modem is still needed. This DS32 PC 3Com LAN modem is used when Autocall is required.

To perform this procedure:

1. Boot the computer with the 3Com LAN modem device connected via the network cable connection.

2. Click **Networking Dialup Connections** and Figure C.2 appears.

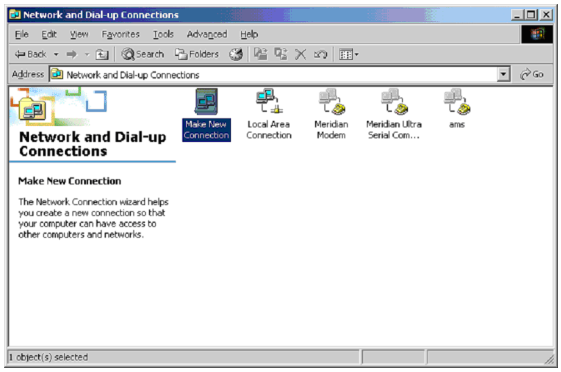

Figure C.2 Network and Dial-up Connections

3. Click **Make a New Connection** and Figure C.3 appears.

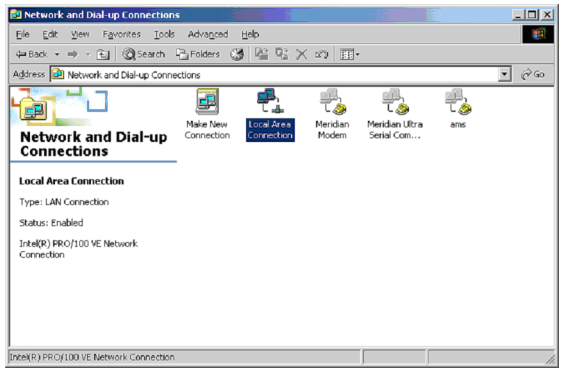

Figure C.3 Local Area Connection

4. Click **Local Area Connection** and Figure C.4 appears.

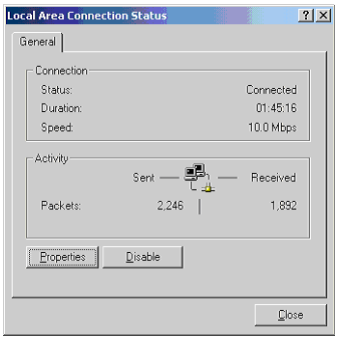

Figure C.4 Local Area Connection Status

5. Click **Properties** and Figure C.5 appears.

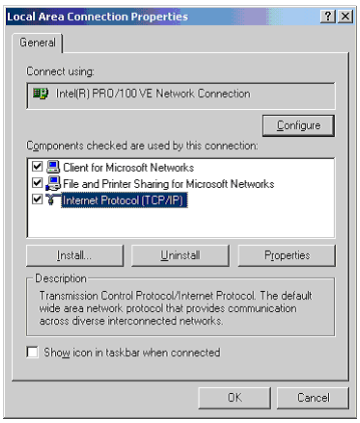

Figure C.5 Local Area Connection Properties

6. Click **Internet Protocol TCP/IP**, click **Properties** and Figure C.6 appears.

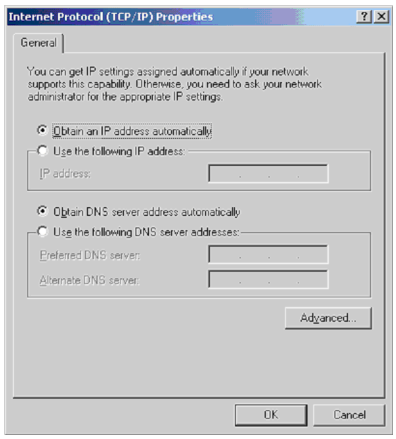

Figure C.6 Internet Protocol (TCP/IP) Properties

7. Click both **Obtain an IP address automatically**, **Obtain DNS server address automatically** and click **OK**.

Set up the 3Com LAN Modem attached to the DS32 PC

To perform this procedure:

1. Press the reset button located on the back of the 3Com device and hold it. While you hold it, the alert light must goes through three sets of flashing. This takes around 30 seconds minimum. This sets the 3Com LAN modem device to the factory default settings.
2. Reboot the attached PC open Windows Internet Explorer. Figure C.7 appears.

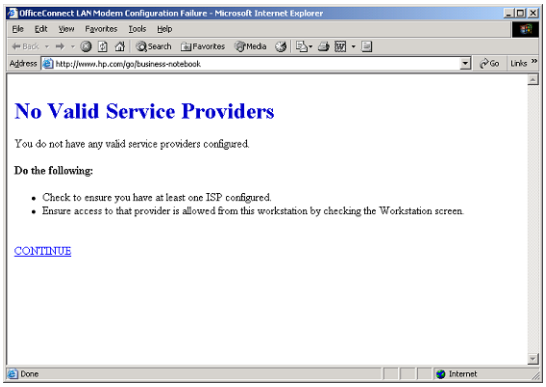

Figure C.7 No Valid Service Providers

3. Click **Continue** and Figure C.8 appears.

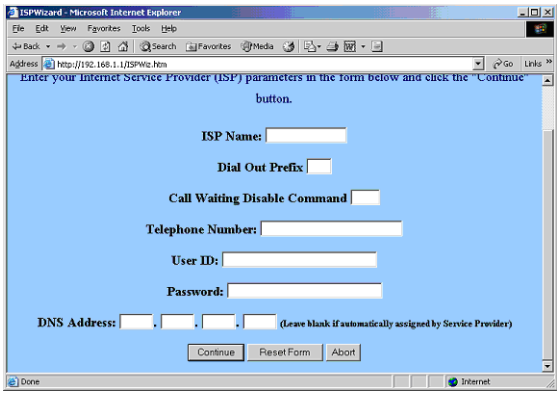

Figure C.8 ISP Wizard

4. Click **Abort** and Figure C.9 appears.

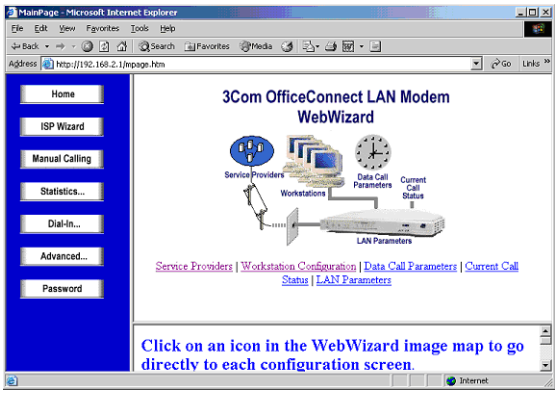

Figure C.9 3Com LAN Modem Wizard

5. Click **Service Providers** and Figure C.10 appears.

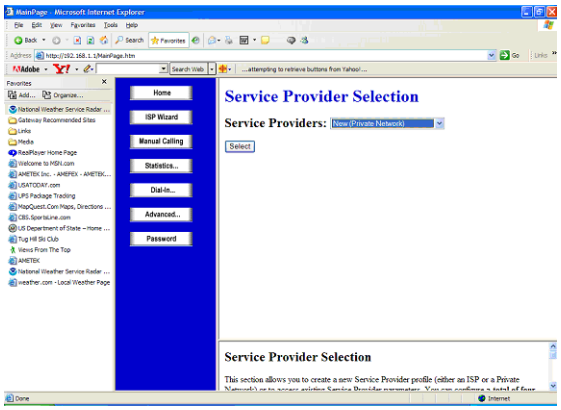

Figure C.10 Service Providers

6. Select *New (Private Network)*, click **Select** and Figure C.11 appears.

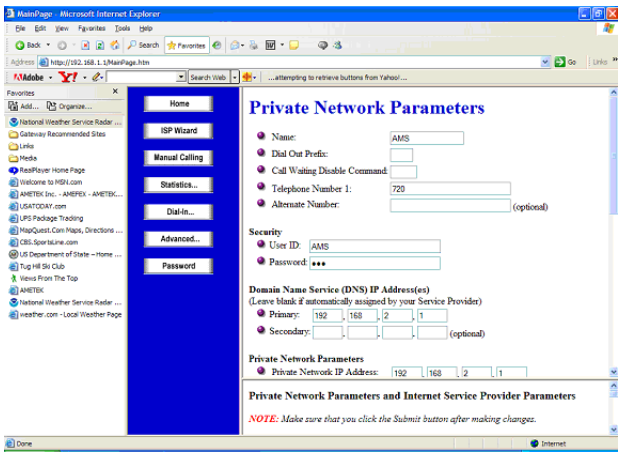

Figure C.11 Private Network Parameters

7. Enter the:

a. *Name*, and *Telephone Number* of the sub-station that you will call.

b. *User ID* and *Password* in *Security* you entered into the remote sub-station 3Com LAN modem that calls in.

c. Sub-station IP's address in *DNS IP address* for the sub-station 3Com LAN modem that calls in.

8. Scroll down and configure the *Private Network Parameters* and *Callback Parameters* as per Figure C.12.

The *Private Network Parameters* are the same are the same as the DNS IP and the subnet is always the same *255.255.255.224*. In Figure C.12, it is *255.255.255.0*, this is incorrect, the last part of the Subnet Mask must always be 224.

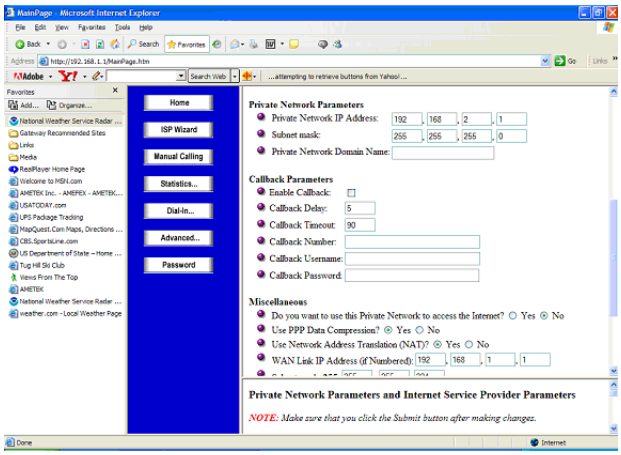

Figure C.12 Private Network Parameters

9. Scroll down and configure the *Miscellaneous Parameters* (Figure C.13 and Figure C.40):

a. Enable the intelligent NAT by clicking **Yes**.

b. Click **No** for *Do yo want to use this Private Network for accessing the Internet.*

c. Click **Yes** for *Use PPP Data Compression*.

d. Enter the *WAN Link IP Address* as the IP address of the 3Com LAN modem attached to the DS32 PC.

e. Enter the *Default Workstation* name (lower on Figure C.12) which is the name of the attached PC and setting up the current 3Com LAN modem.

f. Click **Submit** and the main window reappears.

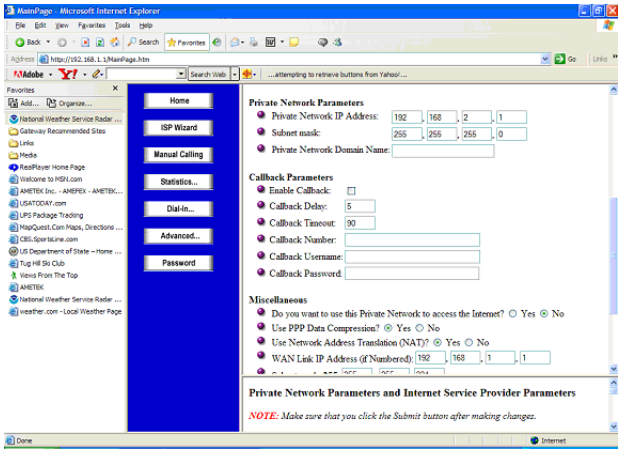

Figure C.13 Private Network DNS Misc. Parameters I

10. Click **Workstation Parameters** and Figure C.14 appears.

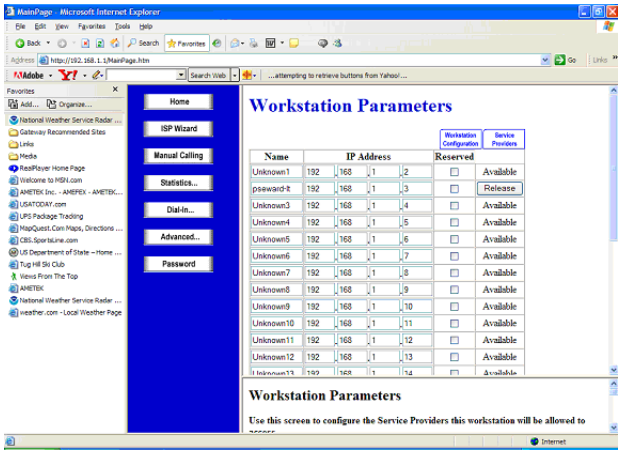

Figure C.14 Workstation Parameters

11. Enter the IP address *192.168.1.2*, which is the IP address of the DS32 PC. On this 3Com LAN modem, none of the IP address's have to be reserved.

12. Click **Submit** and the main window reappears.

Add the Required Autocall Information to the DS32 - 3Com LAN modem

This procedure adds the information of the remote sub-station 3Com LAN modems that will call the 3Com LAN modem attached to the DS32 PC.

To perform this procedure:

1. Click **Dial-In** on the main window and Figure C.15 appears.

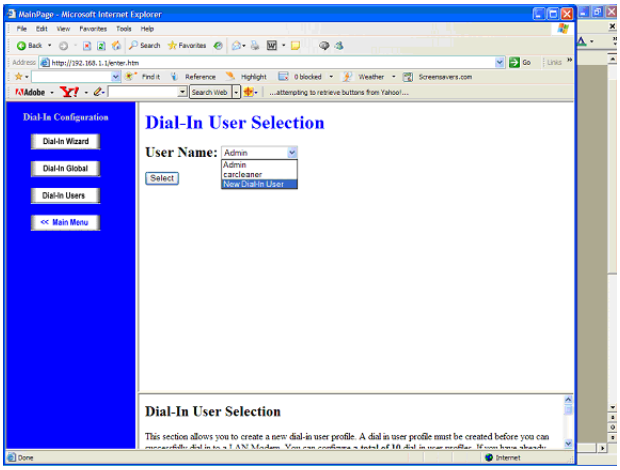

Figure C.15 Dial-In User Selection

2. Click **Dial-In User** and select *New dial in user* under *User Name:* and Figure C.16 and Figure C.17 appears.

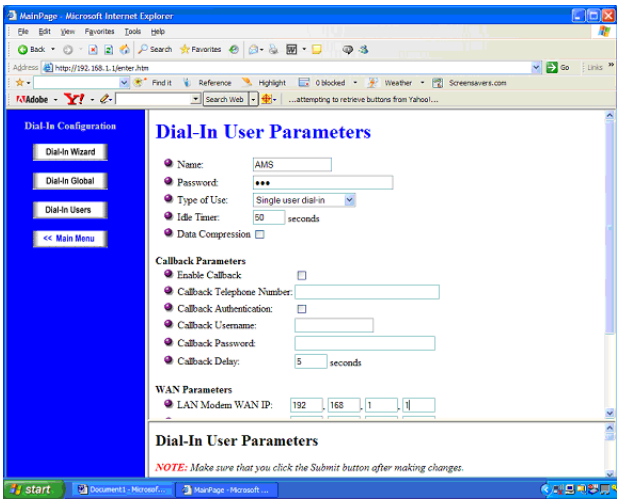

Figure C.16 Dial In User Parameters I

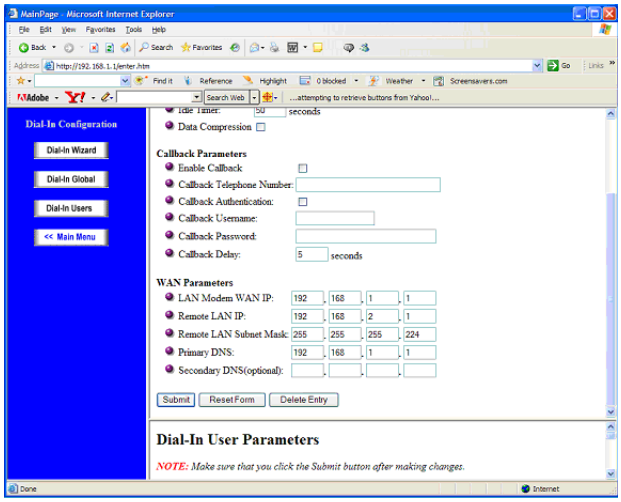

Figure C.17 Dial In User Parameters II

3. Configure this window by:

a. Entering the same *Name* and *Password* that you entered in the remote sub-station 3Com LAN modem that will call in.

b. Configuring the IP network information for the local 3Com LAN modem, which by default is always *192.168.1.1*.

c. Entering the *Remote LAN IP address,* which is the remote 3Com LAN modem's IP address.

d. Entering the *Primary DNS*, which is always the same as the LAN modem *WAN IP address*.

e. Click **Submit** and the main window reappears.

4. Click **Dial in Global** and Figure C.18 appears.

Figure C.18 Dial In Global Parameters

5. Configure this window by:
   a. Setting *Auto Answer* to *1*.
   b. Click **PAP**, **CHAP**, and **MS-CHAP** to activate them.
   c. Click **Submit.**

Setup the DS32 Computer's Network "NIC" Card.

This procedure sets up the DS32's PC internal NIC card, which is attached directly to the 3Com LAN modem. This gives the DS32's PC a static IP address, that can be used with autocall.

To perform this procedure:

1. Open the *Local Area Connection Status* window (Figure C.19).

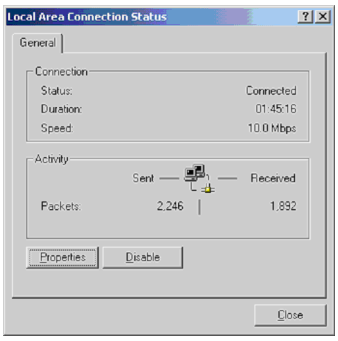

Figure C.19 Local Area Connection Status

2. Click **Properties** and set the DS32 computer's (PC) 3Com modem's *IP address* and *Subnet mask* as shown in Figure C.20. In this case, the Default gateway is always the 3Com LAN modem attached to the PC.

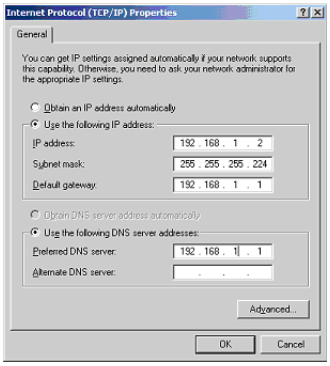

Figure C.20 Internet Protocol (TCP/IP) Properties

Set Up the Master Station DS32 for Use with the 3Com LAN Modem

To perform this procedure:

1. Open DS32 and Figure C.21 appears.

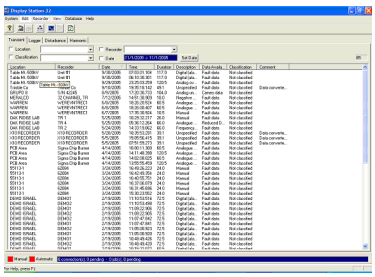

Figure C.21 DS32 Main Window

2. Select *Edit* > *Recorder network* from the pull down.

   The *Recorder Network – Edit* window appears (Figure C.22).

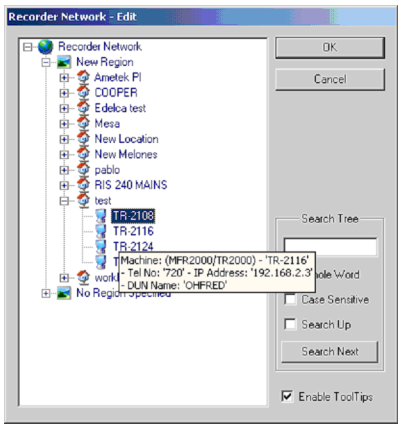

Figure C.22 Recorder Network - Edit

Under *Recorder Network* you can have multiple Regions. For example, you could have a North, South, East, and West Region. Or you could have a region broken down into Counties If it's not a concern or you only have a few recorders, you can just use the Default *New Region* and place all of your locations under that.

3. Add a new Location by right-clicking on the Region and selecting *Add new Location*. The Location is basically the name of the sub-station or sub-station area.

4. Add recorders under the Location by right-clicking on the Location and selecting *Add recorder*.

   As you add the Locations and recorders, you can right click on each one of them and select *Rename location* or *Rename recorder* to change each name. Once you have added your Location and the transient recorders under it, you are ready to add the details of the recorder.

5. Select the new TR and right-click on it to change it's recorder information (Figure C.23).

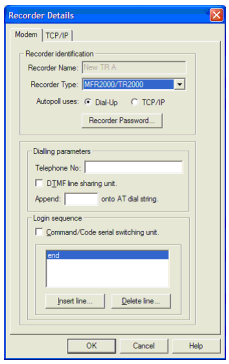

Figure C.23 Recorder Details - Modem Tab

6. Select the *Recorder Type* for this TR.
7. Click **TCP/IP** in *Autopoll Uses*.
8. Click the **TCP/IP** tab and Figure C.24 appears.

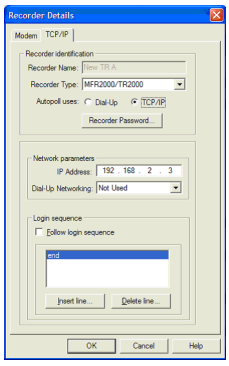

Figure C.24 Recorder Details - TCP/IP Tab

9. Enter the TR's IP address and make sure that you do not change *Dial-Up Networking* if you have already selected an item from the other setup menu. This will normally always have something listed here, if you are also using a bonded async type modem.

Set Up the First Remote Sub-station 3Com LAN Modem

This procedure sets up the 3Com device at the sub-station that is separate from the DS32 PC with the async modem setup.

To perform this procedure:

1. Set up the computer that you plan to use to configure the 3Com device per the following instructions:
   a. Double-click the **Networking dialup connections** icon (Figure C.25).

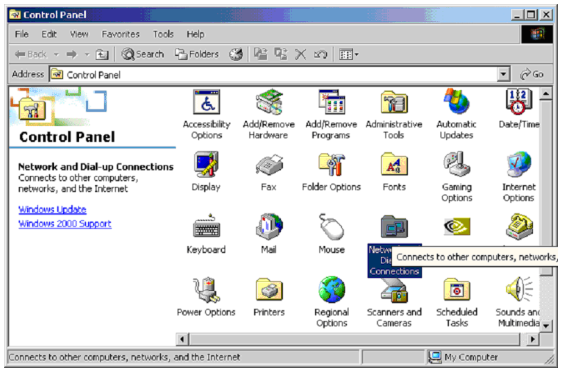

Figure C.25 Networking Dialup Connections Icon

   b. Double-click the **Local Area connection** icon (Figure C.26).

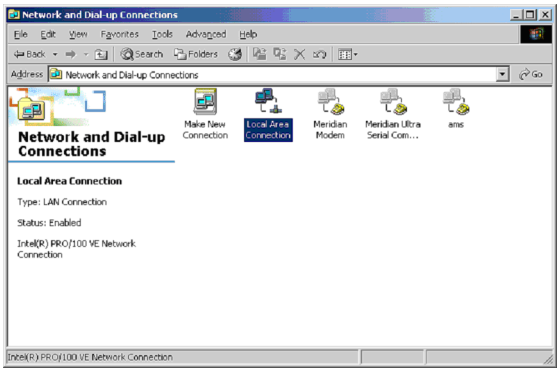

Figure C.26 Local Area Connection Icon

The *Local Area Connection Status* window appears (Figure C.27).

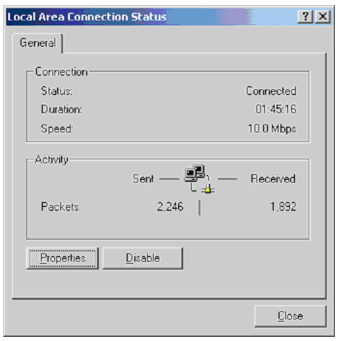

Figure C.27 Local Area Connection Status

c. Click **Properties** and Figure C.27 appears.

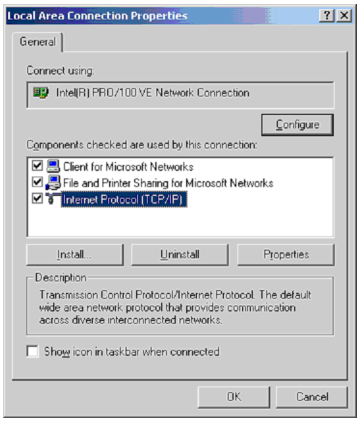

Figure C.28 Local Area Connection Properties

d. Click **Internet Protocol (TCP/IP)** and then click **Properties** and Figure C.29 appears.

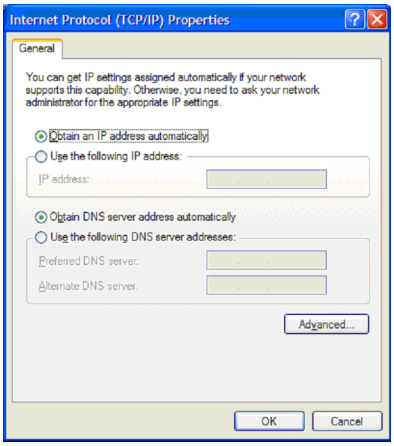

Figure C.29 Internet Protocol (TCP/IP) Properties

2. Click **Obtain an IP address automatically** and **Obtain DNS server address automatically** and click **OK**.

   The PC is now ready to communicate to the 3Com LAN modem that is hooked up to the Transient Recorders at the sub-station. Windows Internet Explorer is used for all communications to the 3Com LAN modem. The next procedure guides you through that.

Set Up the Remote Sub-station 3Com LAN Modem

To perform this procedure:

1. Press the reset button located on the back of the 3Com device and hold it. While you hold it, the alert light must goes through three sets of flashing. This takes around 30 seconds minimum. This sets the 3Com LAN modem device to the factory default settings.
2. Reboot the computer if you are using Windows 2000 and open Window's Internet Explorer. Normally you do not need to reboot Windows XP in this case. Once you open Window's Internet Explorer, Figure C.30 appears.

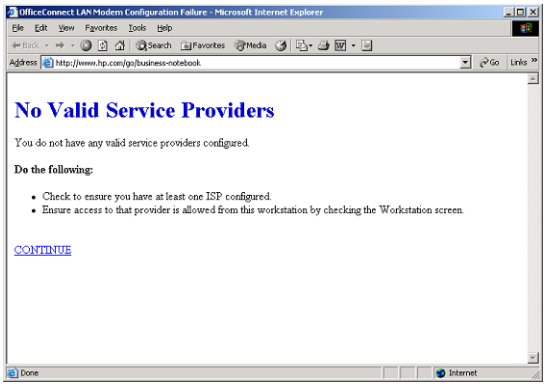

Figure C.30 No Valid Service Providers

3. Click **Continue** and Figure C.8 appears.

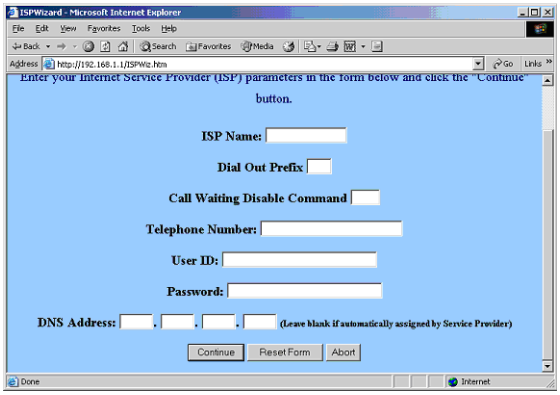

Figure C.31 ISP Wizard

4. Click **Abort** and Figure C.9 appears.

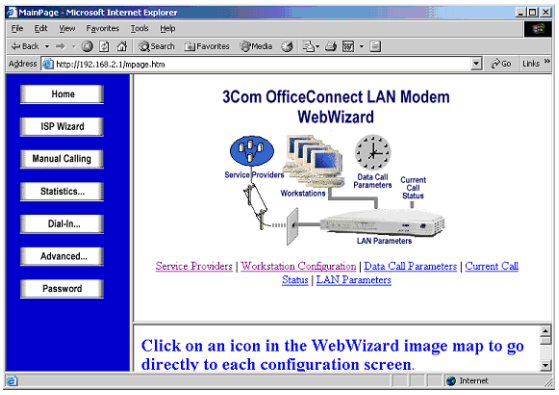

Figure C.32 3Com LAN Modem Wizard

5. Click **Dial-In** and Figure C.33 appears.

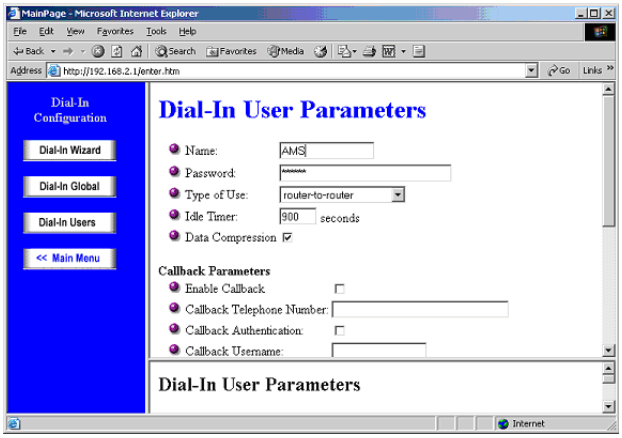

Figure C.33 3Com Dial-In User Parameters

6. Configure this window as follows:

- The name and password must match the setup from what you entered on the Network Connection Wizard window.
- Set all of the following pages with the correct IP addresses for your application.
- The name and password must match the case you entered in the Setup Wizard.
- *Router to Router* must be selected, and *Data Compression* must be checked.
- The *Idle Timer* is set high, that the modem does not hang up if it sees a break in data transfer.

7. Scroll down and set the following parameters (Figure C.34):

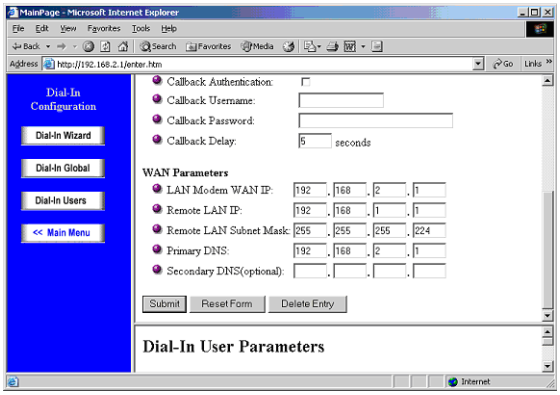

Figure C.34 3Com WAN Parameters

- *LAN Modem WAN IP:* This is the remote sub-station's 3Com's LAN modem's IP address. This is normally the first sub-station that you set up. The second sub-station LAN modem's address is normally *192.168.3.1*, etc.
- *Remote Lan IP*: This is the IP address (by default) of the PC running DS32 (by way of DHCP).
- *Remote Lan IP Subnet Mask*: This is the default Subnet mask and should be used for all 3Com LAN modems or devices talking to them. If you do not use this mask and attempt to go beyond the limit of the 3Com device, the 3Com device will not work.
- *Primary DNS*: This is the same IP address as the Remote Lan IP address.

8. Click **Submit**.

NOTE

Always click Submit before changing screens.

9. Click **Dial-In Global** and Figure C.35 appears.

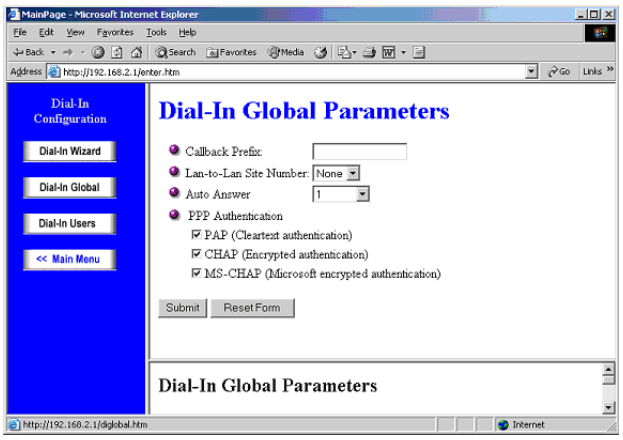

Figure C.35 3Com Global Parameters

10. Configure *Dial-In Global Parameters:*

- Change *Auto Answer* to the *1*
- Click the check boxes for *PAP, CHAP* and *MS-CHAP.*
- Click **Submit**

11. Click **Service Providers** from the main window and Figure C.36 appears.

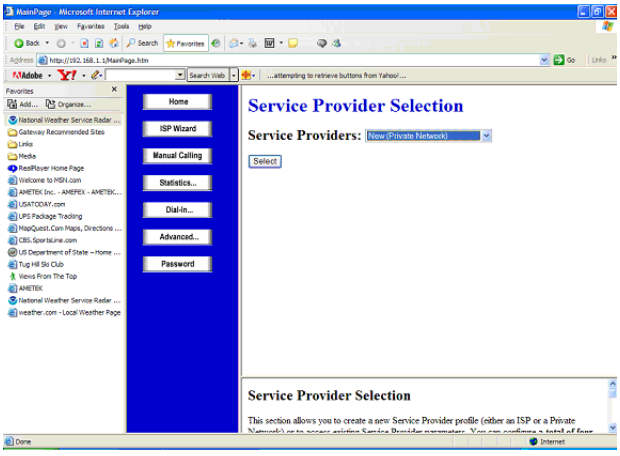

Figure C.36 3Com Service Provider Selection

12. Click **New (Private Network)** and click **Select** and Figure C.11 appears.

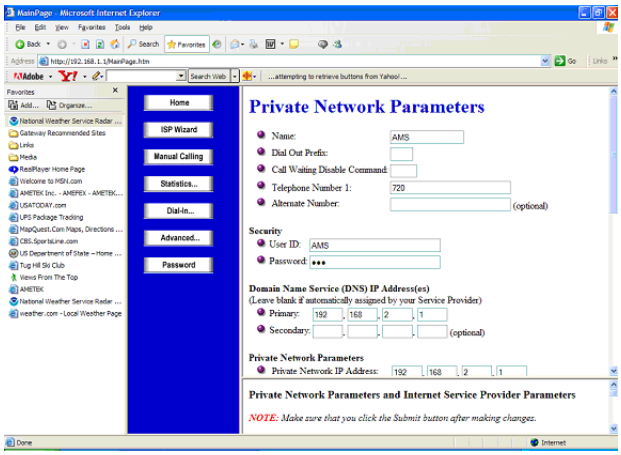

Figure C.37 Private Network Parameters

13. Enter the:

a. *Name* that will call in. In our previous examples we used AMS and/or AMS1 as a default name for all locations. In our example, we are only using one user name and password, at the PC and at the 3Com LAN modems, but this does not have to be the case.

b. *Telephone number* if you have another 3Com LAN modem at the PC running DS32. This phone number is used for Autocalling only, and is not used if you are only using a 3Com LAN modem at the remote sub-station locations.

c. *User ID* and *Password* that you entered under the Network Connection Wizard.

14. Scroll down and configure the DNS parameters (Figure C.38):

a. Enter the *Domain Name Service IP address*. This is by default *192.168.1.1*.

b. The *Private Network Parameters* are the same with the default Subnet Mask.

c. Increase the *Callback Delay* to at least 5 and the *Callback Timeout* to around 90.

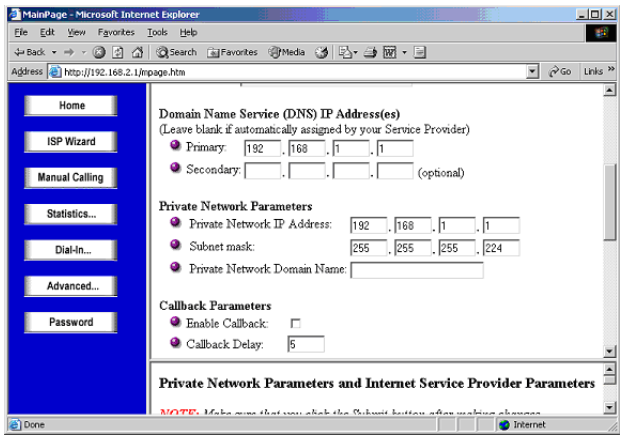

Figure C.38 Private Network DNS Parameters I

15. Scroll down and configure the *Miscellaneous Parameters* (Figure C.13 and Figure C.40):

a. *IP address of the Remote* sub-station 3Com LAN modem that you are currently setting up.

b. The Subnet Mask is always the default Subnet mask.

c. The *Default Workstation* is the PC that is setting up the attached 3Com LAN modem.

d. Enable the intelligent NAT by clicking **Yes**.

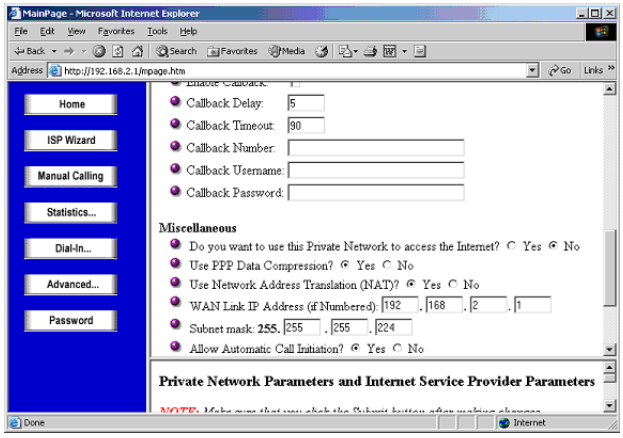

Figure C.39 Private Network DNS Misc. Parameters I

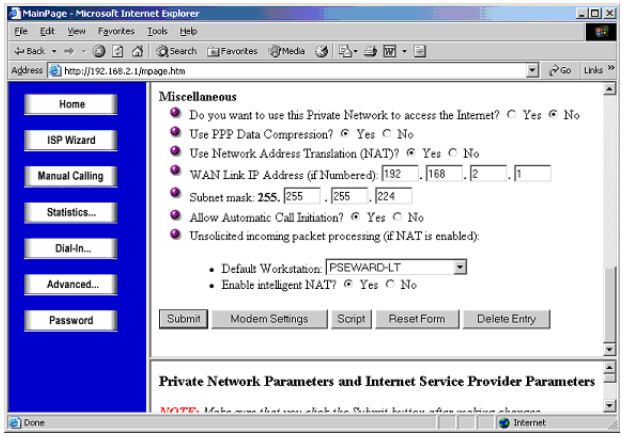

Figure C.40 Private Network DNS Misc. Parameters II

16. Click **Submit** and the *3Com OfficeConnect Lan Modem Web Wizard* window reappears (Figure C.9 on page C-7).

17. Click **Workstation Config** and Figure C.41appears.

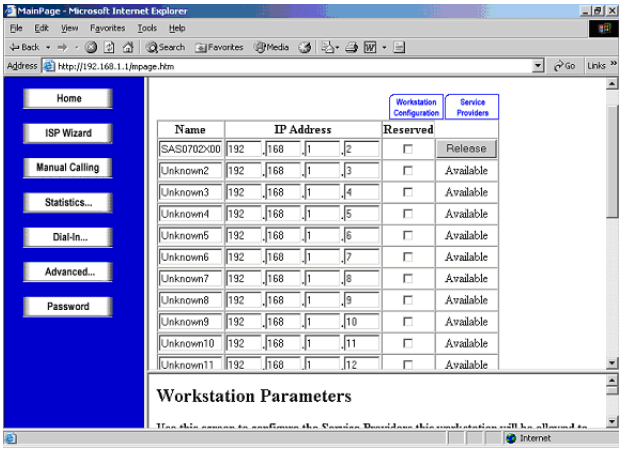

Figure C.41 3Com Workstation Parameters

18. Reserve the static *IP Addresses* for the recorders and the PC that connects to it for future changes:

- *192.168.2.2* is the PC's IP address that is currently connected to it. This is handed out by default by DHCP to the PC by default.
- *192.168.2.3* is the IP address of the first recorder attached
- *192.168.2.4* is the second recorder.

Only the recorders IP address need to reserved.

19. Click **Submit**.

The main 3Com LAN Modem default window reappears (Figure C.9 on page C-7).

20. Click **Data Call Parameters** and Figure C.42 appears. Enter parameters as per the figure.

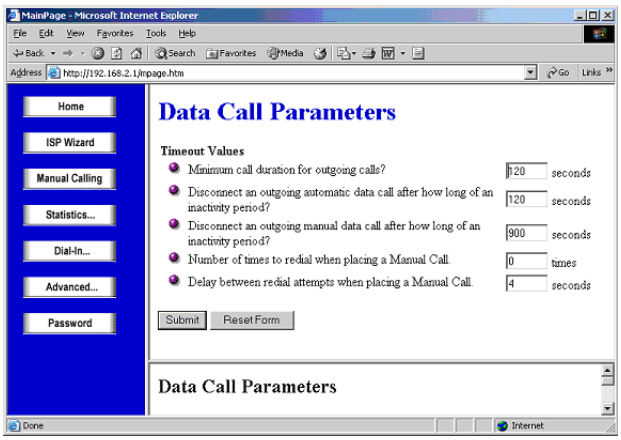

Figure C.42 3Com Data Call Parameters

For *Disconnect an outgoing automatic data call after how long of an inactivity period*, we have set a value of 900 seconds. In some cases this may be too long of a value and can be reduced if needed.

21. Click **Submit** and the main window reappears (Figure C.9 on page C-7).

22. Click **LAN Parameters** and Figure C.43 appears.

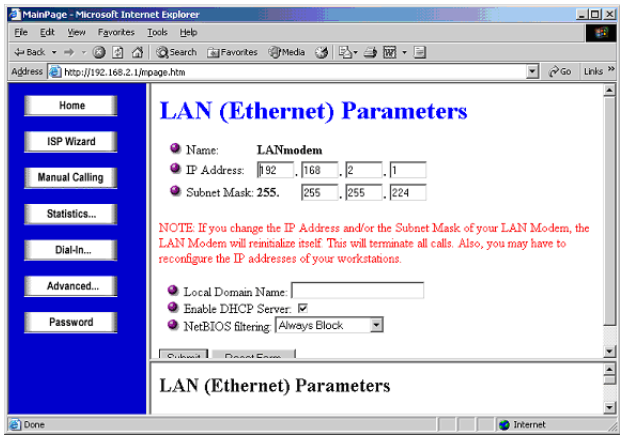

Figure C.43 3Com LAN (Ethernet) Parameters

Configure this screen:

- Change the *IP Address* to the one that you plan on using for this sub-station. As always, enter the default Subnet Mask. To avoid setup problems, for the:
  - First sub-station you would normally use *192.168.2.1*.
  - Second sub-station you would use *192.168.3.1*, and follow this pattern for the rest.

When you change the LAN parameters IP or SUB MASK, it may be necessary to reboot your computer to communicate to the 3Com. As this will most likely put you on a different LAN, DHCP needs to issue a new IP address for your PC.

Set Up the First Remote Transient Recorder

This procedure sets up sub-station A's transient recorder #1's IP address, Subnet Mask, and Router's address, using DS32.

To perform this procedure:

1. Open DS32 and connect to the first transient recorder using the direct connect option and the RS232 direct connect cable.
2. Navigate to the *Recorder Configuration* window (Figure C.44).

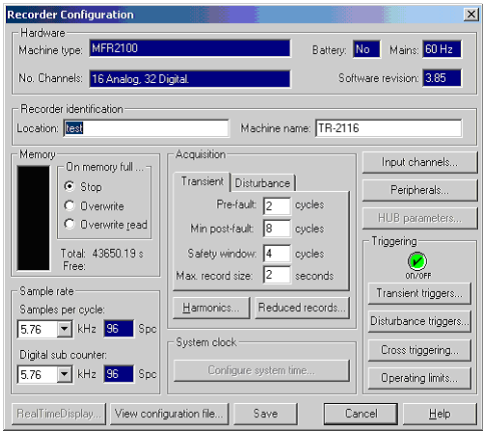

Figure C.44 3Com Recorder Configuration

3. Click **Peripherals** and Figure C.45 appears.

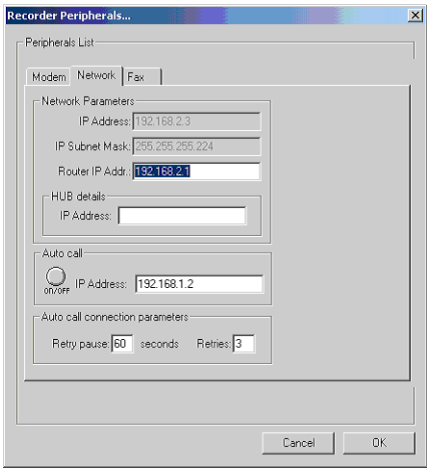

Figure C.45 3Com Recorder Peripherals

4. Enter the *IP Address* for that recorder. The default IP Subnet Mask always remains the same.
5. Enter the *Router IP Addr,* the IP address of the router to which the transient recorder attaches.
6. Click **OK** and click **Setup**. You can now disconnect from this unit and proceed to the next unit.

Set Up the Second Remote Transient Recorder

To perform this procedure:

1. Move the RS232 cable to the next transient recorder and connect to it using DS32 and the direct connect option with the RS232 direct connect cable.
2. Navigate to the *Recorder Configuration* window (Figure C.46).

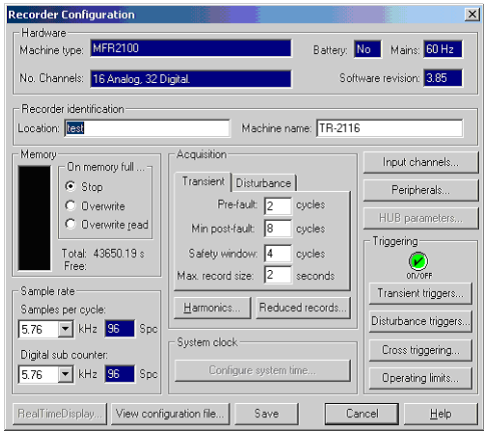

Figure C.46 3Com Recorder Configuration

3. Click **Peripherals** and Figure C.47 appears.

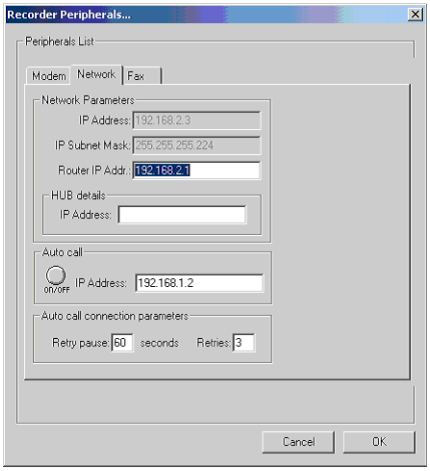

Figure C.47 3Com Recorder Peripherals

4. Enter the *IP Address* for that recorder. The default IP Subnet Mask always remains the same.
5. Enter the *Router IP Addr,* the IP address of the router to which the transient recorder attaches.
6. Click **OK** and click **Setup**. You can now disconnect from this unit and proceed to the next unit.

Set Up the DS32 Transient Recorders for Autocall

Figure C.48 shows the default DS32 main window.

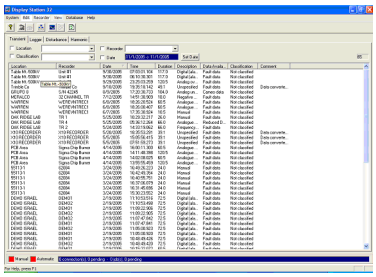

Figure C.48 DS32 Main Window

To perform this procedure:

1. Select *System* > *Auto-poll/call* and Figure C.49 appears.

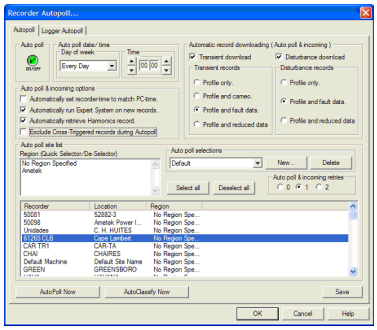

Figure C.49 Recorder Autopoll

The majority of this window is for autopolling, which we are not concerned with at this point in time. In the upper right hand corner of the window, note the word *incoming* in *Automatic record downloading (Auto poll & incoming)*. This word applies to DS32 Autocall or Autocalling options.

2. Select the type of records you want retrieved by Autocall and what type of data.
3. Set up the Autocall TRs by selecting *Edit – Recorder Network* on the main window Figure C.48 and appears.

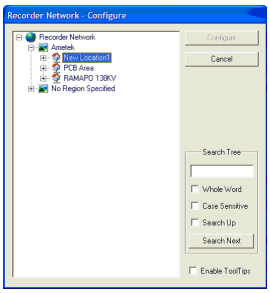

Figure C.50 Recorder Network - Configure

4. Select the Location and the Recorder that you want to assign the Autocall option (Figure C.51).

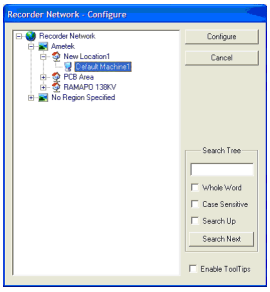

Figure C.51 Recorder Network - Configure Location

You could also do this online while connected to the recorder. In this example, we are setting up Autocall off line. When it is set up off line, you are required to call up or to connect to the TR and download the configuration.

5. Open the *Recorder Configuration* window (Figure C.52) and click **Peripherals**.

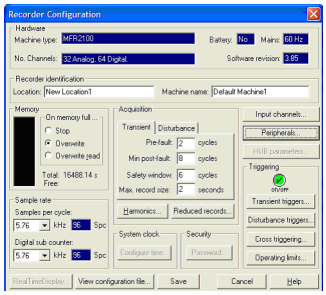

Figure C.52 Recorder Configuration

The *Recorder Peripherals* window appears (Figure C.53).

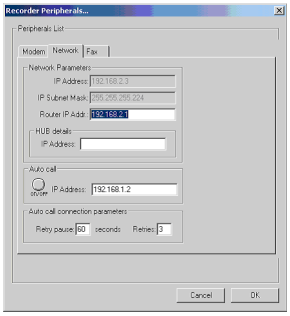

Figure C.53 Recorder Peripherals

6. Enter the *IP Address* of the DS32 PC's 3Com LAN modem in *Auto Call*.
7. Click the **Auto Call** ON/OFF button if you want this TR to Autocall each time a new record is captured.

Appendix D. Contact List

Telephone/Fax Number List

Use these numbers for ordering equipment, application assistance, technical support, and scheduling field service

NOTE

Your instruction manual may contain other phone and fax numbers; this list takes precedence.

MAIN OFFICE

AMETEK Power Instruments – Rochester

255 North Union St., Rochester, NY 14605

Table D.1 Ametek Main Office Contact Numbers

Department/Product Line	Telephone	Fax
MAIN PHONE	585-263-7700	585-262-4777
FIELD SERVICE	800-374-4835	585-238-4945
REPAIRS/RETURNS	888-222-6282	585-238-4945
SALES SUPPORT	800-950-6676	585-454-7805

FAR EAST OFFICE

AMETEK Power Instruments
271 Bukit Timah Road, #03-09
Balmoral Plaza, Singapore 259708
Tel: 65-732-8675
Fax: 65-732-8676

UK OFFICE

AMETEK Power Instruments
Unit 20, Ridgeway
Donibristle Industrial Estate
Dunfermline, UK
Tel: 1383-825630

Fax: 1383-825715

Appendix E. TR-2000 Application Note Synchrophasor Output to IEEE P37.118

This document describes the implementation of the standard P37.118 as used in the AMETEK TR-2000 recorder and should be read in conjunction with the standard itself and tries to follow formats used there. You should also consult the AMETEK Display Station Operation Manual and the TR-2000 User Guide for further information. For information on installing the new recorder firmware, if this is required, consult the AMETEK Recorder Firmware Upgrade guide.

The synchrophasor output provides data via the COM2 port located at the rear of the instrument. Enable the output by setting DIL switch 2/6 on the master acquisition card within the instrument.

Data output is provided in three forms viz: header, configuration and data frames. Of these the data frames are output spontaneously at a rate pre-defined by the transmission period setting. The configuration and header frames are output on command from the receiving device. There are some restrictions on the full range of output options allowed for in the standard. The exact frame formats and limitations used are detailed below.

Baud rate data selection and other set up parameters are entered via the Display Station package. The settings are found at the Phasor Display tab under Input Channel Selection. Note that this is only shown if the instrument is set for synchrophasor output via the switch. The parameters available include Header, Station Name, Identity, Baud rate and data transmission Period. Display Station also allows selection of the phasor, analog and digital data to be transmitted. The Baud rate may be selected from 9600, 19200, 38400 and 57600. Period may be selected from 20mS at 50Hz or 16.66mS at 60Hz to 1S per data frame. Display Station will also check that the transmission period and quantity of data requested are compatible with the available baud rate.

This is a factory fitted option for the TR-2000.

Table E.1 Data Frame (Spontaneous Output)

No	Field	Size	Value (if fixed)	Comment
1	SYNC	2	AA01	Synchronization byte followed by frame type and version number. Note that the version number is 01
2	FRAMESIZE	2		Number of bytes in frame including SYNC and CRC. (132 max)
3	SOC	4		Second count. (UNIX time, starting midnight 01-Jan-1970).
4	FRASEC	4		Bits 0-23 contain fraction of second sample time related to the MEAS_RATE parameter in the configuration frame.
5	STAT	2		Bit mapped flags. Bit 14 is set by a PMU error. Bit 13 is set by a sync error. Other bits are not included in this implementation.
6	PHASORS	4 x PHNMR		Phasors are in signed 16-bit rectangular format Polar and floating-point options are not supported. This reflects the internal formats of the MFR. The phasors included are selected by the Display Station package. Up to 10 may be included. Note that the data transmitted is the Positive Phase Sequence, current or voltage
7	FREQ	2		Frequency deviation (signed 16-bit only, Hz * 1000)
8	DFREQ	2		Rate of change of frequency (signed 16-bit only, Hz/S * 100)

Table E.1 Data Frame (Spontaneous Output) (Continued)

9	ANALOG	2 x ANNMR		This field holds 16-bit RMS representations of the MFR inputs. The values included are selected by Display Station package. Up to 32 may be included.
10	DIGITAL	(2 x DGNMR) / 16		This field holds digital input data. Note that this field is compacted with 16 inputs per word.
11	CHK	2		CRC16

Table E.2 Configuration Frame (On Command)

No	Field	Size (bytes)	Value (if fixed)	Short Description
1	SYNC	2	0xAA21 0xAA31	Synchronization byte followed by frame type and version number. Since the MFR has only one configuration available this implementation responds to both configuration type requests with the same frame except the SYNC word.
2	FRAMESIZE	2		Number of bytes in frame including SYNC and CRC (max 2046)
3	SOC	4		Second count. (UNIX time, starting midnight 01-Jan-1970).
4	D_FRAME	2	0x0000	Data frame format. This is fixed as including a CRC16

Table E.2 Configuration Frame (On Command) (Continued)

5	MEAS_RATE	4		Number of samples per second, used for time stamping the data frame. In this implementation this is based on the primary rate of phasor calculation within the MFR i.e. once per half cycle. (100 or 120)
6	NUM_PMU	2	0x0001	The number of PMUs included in the data frame. This is fixed at 1 in this implementation
7	STN	16		Station Name – 16 bytes in ASCII format
8	IDCODE	8		8 bytes in ASCII – PMU hardware identification.
9	FORMAT	2	0x000C	Data format within the data frame. Fixed as first sample sync, rotating phasors, 16-bit and rectangular in this implementation.
10	PHNMR	2		Number of phasors – 16-bit integer. Maximum is 10.
11	ANNMR	2		Number of analogue values – 16-bit integer. Maximum is 32.
12	DGNMR	2		Number of digital channels – 16-bit integer. Maximum is 64.
13	CHNAM	16 x (PHNMR + ANNMR + DGNMR)		Phasor and channel names – 16 bytes per phasor, analog and digital channel in ASCII format in the same order as they are transmitted

Table E.2 Configuration Frame (On Command) (Continued)

14	PHUNIT	4 x PHNMR		Conversion factor for phasor channels. Bit 24 =1 for current. Bits 0-23 in Amps or Volts*10^5
15	ANUNIT	4 x ANNMR		Conversion factor for analog channels. Bit 24 =1 for current. Bits 0-23 in Amps or Volts*10^5
16	DIGUNIT	2 x DGNMR		Conversion factor for digital channels. Bit 4 – Word normal state. Bit 0 – Input normal state.
17	FNOM	2		Nominal line frequency code for 50/60 Hz. In this implementation FREQ and DFREQ are always included in the data frame. Bit 0 = 1 for 50Hz.
18	PERIOD	2		Period of phasor data transmissions. Signed 16-bit number in cycles * 100. Minimum of once per cycle to once per second.
19	CHK	2		CRC16

Table E.3 Header Frame (On Command)

No	Field	Size (bytes)	Value (if fixed)	Short Description
1	SYNC	2	AA11	Synchronization byte followed by frame type and version number.
2	FRAMESIZE	2		Number of bytes in frame including SYNC and CRC

Table E.3 Header Frame (On Command) (Continued)

3	SOC	4		Second count. (UNIX time, starting midnight 01-Jan-1970).
4	DATA 1	1		ASCII character, 1st byte
N-1	DATA k	1		ASCII character, last byte in message In this implementation the maximum is 2038
N	CHK	2		CRC16

Table E.4 Command Frame (Incoming)

No	Field	Size (bytes)	Value (if fixed)	Short Description
1	SYNC	2	0xAA41	Synchronization byte followed by frame type and version number.
2	FRAMESIZE	2	0x0014	Number of bytes in frame including SYNC and CRC.
3	SOC	4		Second count. (UNIX time, starting midnight 01-Jan-1970).
4	IDCODE	8		Corresponding to that in the configuration frame
5	CMD	2		Command Number – see Table E.5
6	CHK	2		CRC16

Table E.5 Commands Implemented

Command Word Bits	Definition
Bits 15-4	Reserved for future use
Bits 3-2-1-0:	
0001	Turn off real-time data
0010	Turn on real-time data
0011	Send HDR frame
0100	Send CFG – 1 frame
0101	Send CFG - 2 frame
1000	Not Implemented

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