GE MULITILIN ™

PMCS Waveform Capture

User's Guide
GEH-6511

GE Multilin PMCS

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Spectra MicroVersaTrip	469 Motor Management Relay	EPM 7300 Electronic Power Meter
EPM 7600 Electronic Power Meter	EPM 7500 Electronic Power Meter	EPM 7330 Electronic Power Meter
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Enhanced MicroVersaTrip-D	565 Feeder Management Relay	EPM 3710 Electronic Power Meter
MDP Overcurrent Relay	735 Feeder Relay	EPM 3720 Electronic Power Meter
750/760 Feeder Management Relay	SR745 Transformer Management Relay	Spectra Electronic Control Module
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Introduction

Welcome

Waveform Capture is a GE MULTILIN™ PMCS tool that helps you increase productivity, reduce downtime, and improve power quality by analyzing current and voltage waveforms and the associated harmonic data. By selecting voltage and current waveforms, you can use Waveform Capture to examine selected devices in your system. Waveform Capture uses your PMCS power management network to retrieve captured and recorded waveform data from power management devices. The waveform and harmonic information collected provides you with the following benefits:

- **Improved power quality** – Identifies sources of "dirty" power, otherwise invisible, and takes corrective action to save wear, tear, and possible damage to critical equipment.
- **Faster corrective maintenance** – Pinpoints the root causes of problems using triggered waveform capture.
- **Higher productivity** – Frees up maintenance and repair personnel to perform other needed duties.
- **Less downtime** – Identifies and corrects problems before they lead to loss of power or costly damage to loads such as production equipment and computers.
- **Increased safety** – Provides a centralized source of information, which reduces the need for physical contact with equipment and shop floor presence.

About Waveform Capture

The Waveform Capture application is a Windows based package that communicates with the PMCS Dynamic Data Exchange (DDE)/OPC server. The PMCS DDE/OPC server is a Microsoft Windows application that allows other Windows applications (clients) to access data from GE and other third-party devices.

Waveform Capture is easy to use. It provides Windows toolbar and pull-down menus for quick and easy waveform capture and display, in addition to current, voltage, and phase selection for waveform and harmonic data.

This release of Waveform Capture provides complete support for the devices listed below in

Name	Device Type	Function
POWER LEADER Meter	PLM	Metering
Power Quality Meter (PQM)	MLPQM	Metering
Power Quality Meter (PQMII)	PQMII	Metering
Electronic Power Meter 3710	E3710	Metering/Control
Electronic Power Meter 3720	E3720	Metering/Control
Electronic Power Meter 7500	E7500	Metering/Control
Electronic Power Meter 7600	E7600	Metering/Control
Electronic Power Meter 7700	E7700	Metering/Control
SR469 Motor Management Relay	ML469	Protection/Control
SR369 Motor Management Relay	ML369	Protection/Control
SR489 Generator Management Relay	ML489	Protection/Control
SR745 Transformer Management Relay	ML745	Protection/Control
SR750 Feeder Management Relay	ML750	Protection/Control
SR760 Feeder Management Relay	ML760	Protection/Control
Universal Relay devices	UR	Depends on modules installed; usually Protection/Control and/or Metering
Electro Industries Meter EPM9450Q	EPM9450Q	Metering/Control
Electro Industries Meter EPM9650Q	EPM9650Q	Metering/Control
Electro Industries Meter EPM7450D	EPM7450D	Metering/Control
F650 Bay Controller	F650	Protection/Control
Entellisys Low Voltage Switchgear	EntellisysLVS	Protection/Control
MIFII Feeder Management Relay	MIFII	Protection/Control

Table 1. Supported Device Types.

Theory of Operation

Waveform Capture software consists of two components, the Waveform Server and the Waveform Client. For brevity, we'll refer to these as the WFServer and WFClient, respectively. You enter a request for a waveform for a particular device at the WFClient. The WFClient passes this request to the WFServer (for most PMCS devices) or to the GE 7700 Gateway Server (for the EPM 7700, EPM 7600 and EPM 7500). The WFServer in turn passes the request to the PMCS DDE Server, which issues the command to the device, collects the necessary data and passes the data back to the WFServer. The GE 7700 Gateway Server collects its data from the PML Pegasys Comm Server. Once the Gateway or WFServer receives the data in response to its request, it collates the data into a file for viewing at the Waveform Capture Client.

Multiple WFClients may request data from the same WFServer or GE 7700 Gateway. As shown below in Figure 1, these Clients may reside on the host PC (exchanging data with the Waveform Capture Server via DDE communications) or on separate networked PCs. WFClients may communicate with WFServers on remote PCs using either NetDDE or DCOM communication protocols to exchange data with the Waveform Server. WFClients may only communicate with GE 7700 Gateway Servers on remote PCs using NetDDE communications. (The WFServer and PMCS DDE Server must be installed on the same host PC.)

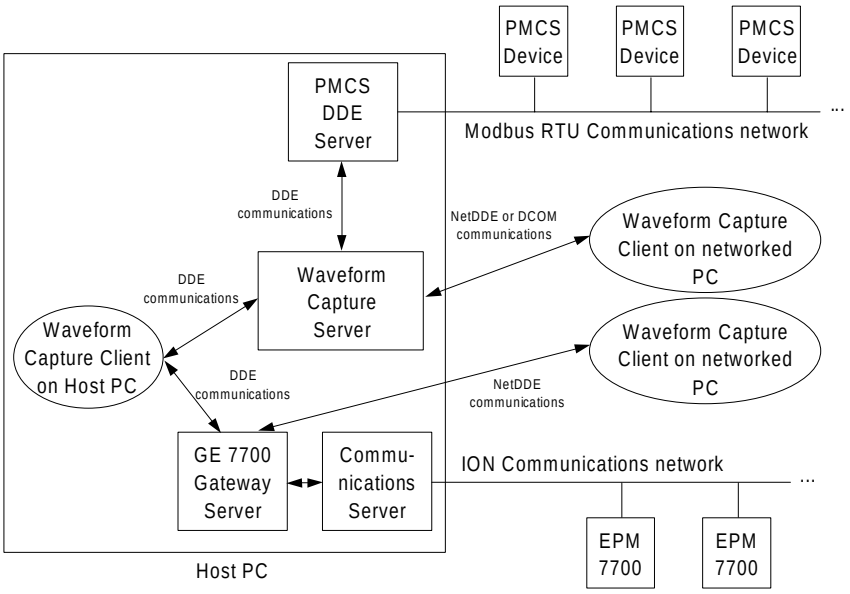

Figure 1. Waveform Capture operation.

The WFClient allows you to trigger a waveform capture at a device and retrieve the data for display and analysis. This action is called manual waveform retrieval.

Individual devices may be set up to automatically capture a waveform based on triggering criteria, such as a fault or a user-defined parameter being exceeded. The WFServer offers an automatic retrieve mode that monitors selected devices. If the WFServer detects that a device has automatically captured a waveform, the WFServer retrieves the waveform and saves the waveform data to a file for later analysis. This is called automatic waveform retrieval.

In both automatic and manual waveform retrieval, the waveform data is saved to a file as soon as the data is retrieved by the Waveform Capture Server.

Remote Waveform Capture Servers

PMCS Waveform Capture Client has the ability to collect waveform data from multiple Servers. WFClient maintains a list of Servers to monitor, and presents a single, unified interface to all waveform-capable devices

across all monitored WFServers or GE 7700 Gateway Servers. The only constraints are that the WFServer must be on the same Host PC as the PMCS DDE Server, and there is a limit of one WFServer and one GE 7700 Gateway per PC.

An example of this multi-server, multi-client capability is shown below in Figure 2.

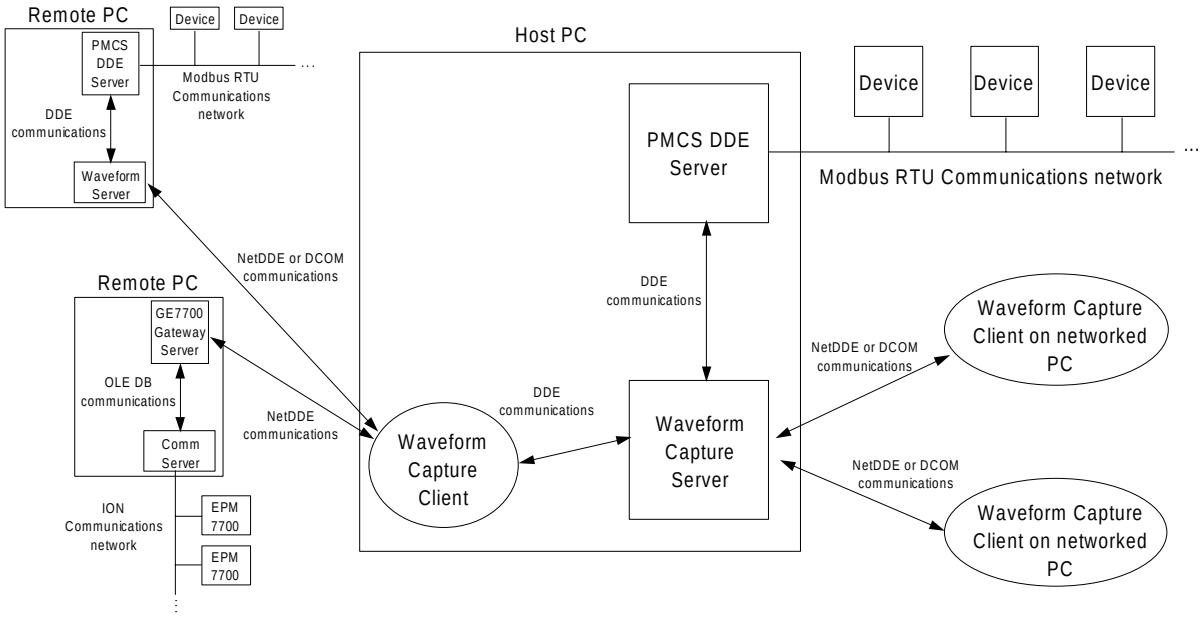

Figure 2. Waveform Capture operation with Remote Servers.

NOTE: If multiple DDE and WFServers are being used, you must be careful to avoid duplicate device names on any of the connected networks as the WFClient cannot differentiate between devices with the same DDE topic name. In addition, a maximum of one GE 7700 Gateway can be configured in any Waveform Client.

DDE Communications vs. DCOM Communications

The Waveform Clients typically communicate with the Waveform Server using the Dynamic Data Exchange (DDE) and Network DDE (NetDDE) communications as described thus far in the theory of operations section.

However, in some network circumstances, the NetDDE protocol is inappropriate. Specifically, when the client applications are being required to communicate with Servers located across multiple IP networks, the NetDDE protocol is unable to resolve the multiple network addresses required. NetDDE was designed to operate on a single subnet only and cannot cross the network boundary imposed by an IP router. If multiple networks are required for your PMCS application, the Distributed Communications (DCOM) communications interface should be selected during WF Server configuration. Details of this are discussed in Waveform Menu ▶ Configure Application on page 25.

On any given Waveform Client installation, all communications to Waveform Servers must use the same communications protocol (NetDDE or DCOM). Likewise, all communications to GE7700 Gateway must use the same communications protocol (NetDDE or DCOM). A single client may not communicate to one Waveform Server with NetDDE and to a second with DCOM. However, a single client *may* be configured to communicate with a Waveform Server via DCOM, and to a GE7700 Gateway via NetDDE.

Installation

Installation of the Waveform Capture application software is not covered in this document. Refer to GEH-6514 *PMCS Read This Book First* for InTouch *and* DEH-211 *PMCS Read This Book First* for Cimplicity, for complete installation procedures for all GE MULTILIN™ system and application software packages.

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Quick Start

Getting Started

The Waveform Capture software has been designed to be as user-friendly as possible. The instructions in this chapter walk you through a basic setup and waveform capture step by step, with screenshots from an actual waveform capture. If you're familiar with the PMCS DDE Server, and your network and devices have been properly configured, this chapter is enough to get you up to speed and capturing waveforms in a matter of minutes.

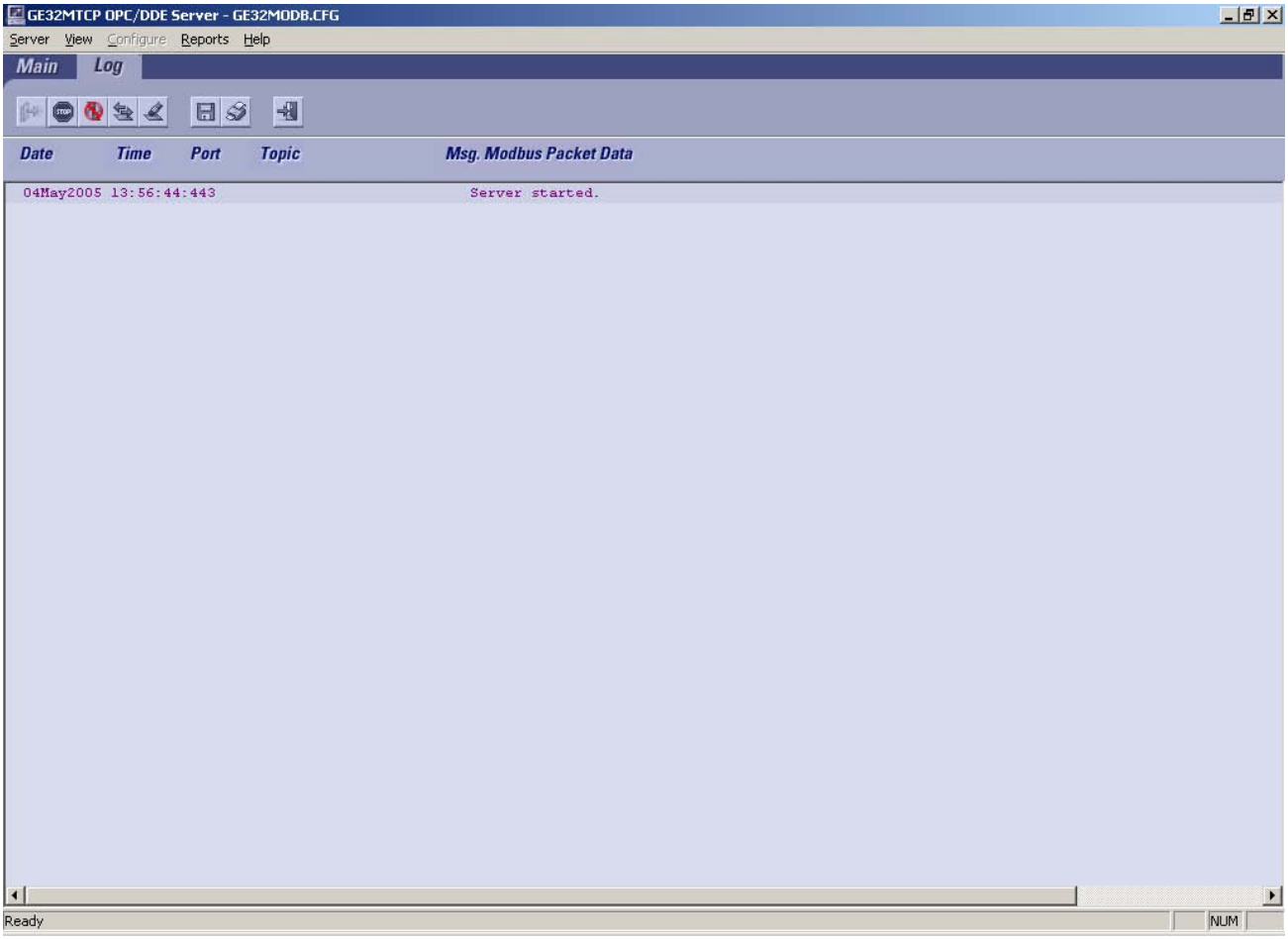
The basic procedure to capture and display waveform data consists of these five steps:

1. Make sure the PMCS DDE Server is running. If you are using the EPM 7700, EPM 7600 or EPM 7500 device, the PML Communications Server must also be started at this point; see GEH-40035, the *GE 7700 Gateway User's Guide* for details.
2. Make sure the Waveform Capture Server is running; make sure the 7700 Gateway is running if you're using the EPM 7700, EPM 7600 or EPM 7500 device.
3. Start the Waveform Capture Client.
4. Select the desired device and trigger the waveform capture.
5. Select the type of display and parameters you want to see.

1. Make sure the *PMCS* DDE Server and/or PML Comm Server is running.

The PMCS DDE Server (if you are going to use the GE Waveform Server) and/or the PML Communications Server (if you are going to use the GE Gateway software to communicate with EPM 7700, EPM 7600 or EPM 7500 devices) should be running before you start either the WFServer or the WFClient (or GE Gateway if using EPM 7700, EPM 7600 or EPM 7500). For example, if the GE32MODB Server is not running when you launch the WFServer, the WFServer will display an error box with this message: **Connection could not be established with GE32MODB. Make sure that the DDE Server is working properly!**

When the PMCS DDE Server is launched, you should see a window similar to:

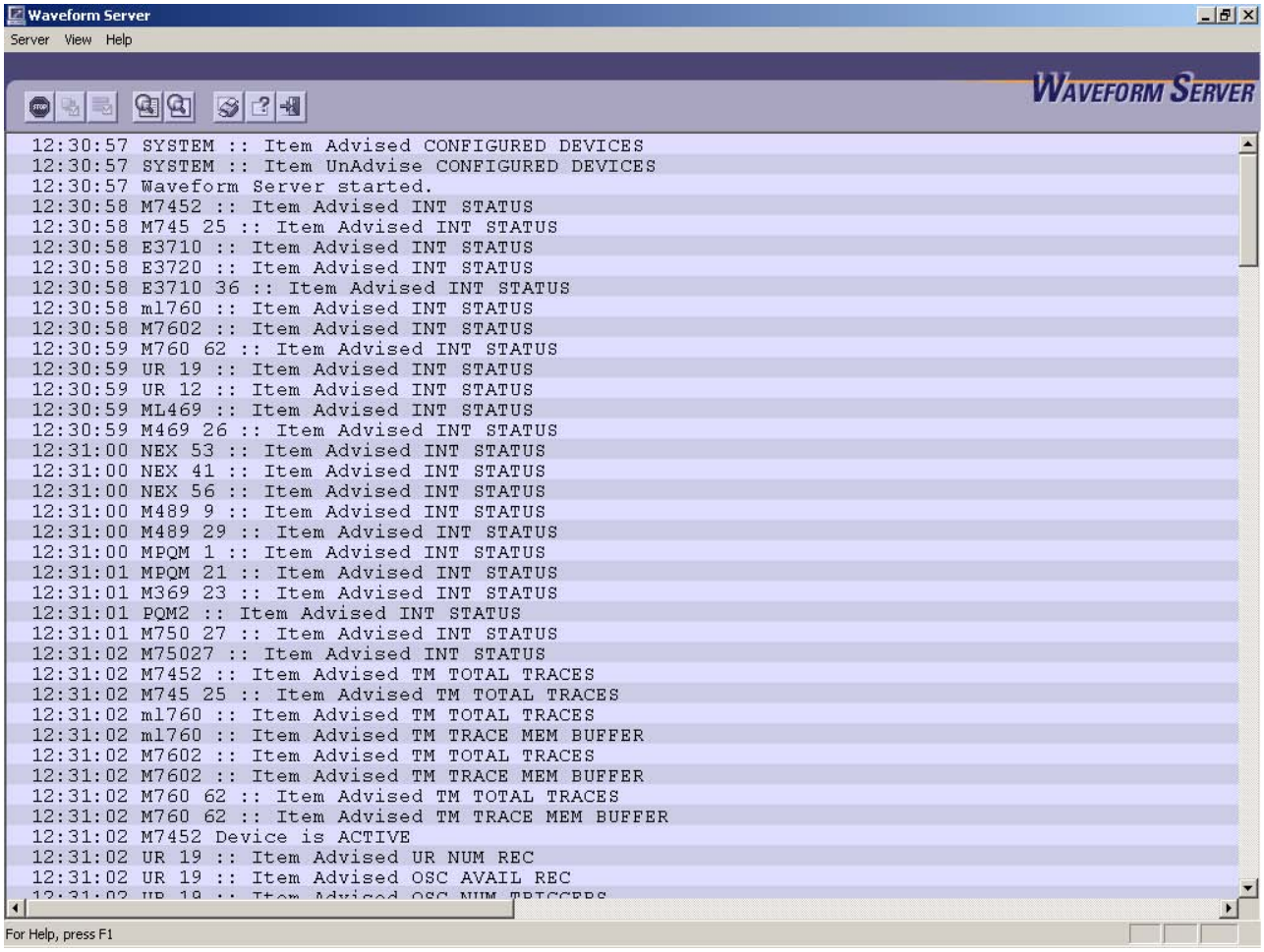


For purposes of this publication, we'll assume that you've already correctly configured the PMCS DDE Server with the devices connected to your network, and that if you're using the EPM 7700, EPM 7600 or EPM 7500, that the GE 7700 Gateway has been configured. If you have any questions regarding setup or launching of the PMCS DDE Server, please refer to GEH-6510, *PMCS DDE Server User's Guide*.

2. Make sure the WFServer and/or 7700 Gateway is running.

Next, the WFServer (and/or 7700 Gateway Server, if you're using the EPM 7700, EPM 7600 or EPM 7500 device) must be started prior to launching the WFClient.

A screen similar to the one shown below appears when you launch WFServer. (Refer to DEH-40035 for examples of the GE 7700 Gateway Server screens.)



The WFServer gets all its device configuration data from the PMCS DDE Server's "System" topic, so no special configuration of the WFServer is necessary under normal circumstances. Remember that the WFServer and PMCS DDE Server must be installed on the same host PC. If you attempt to use the WFServer on a machine where the PMCS DDE Server is not installed, the WFServer will display a **Connection could not be established** error message. The WFServer is discussed in more detail in Chapter 4.

If you're using the EPM 7700, EPM 7600 or EPM7500 device and GE 7700 Gateway Server, you should refer to DEH-40035 for configuration instructions. If properly configured, the Waveform Capture Client requires no special configuration to function with the GE 7700 Gateway Server, it merely needs to be told where to find the Gateway's configuration file.

3. Start Waveform Capture Client.

Once both the PMCS DDE Server and the WFServer and/or GE 7700 Gateway are running, launch the Waveform Capture Client.

The Waveform Capture program icon, labeled Waveform Capture or WFC, is shown below. You'll find it in the GE PMCS program group.

Double click on the icon to start the program.

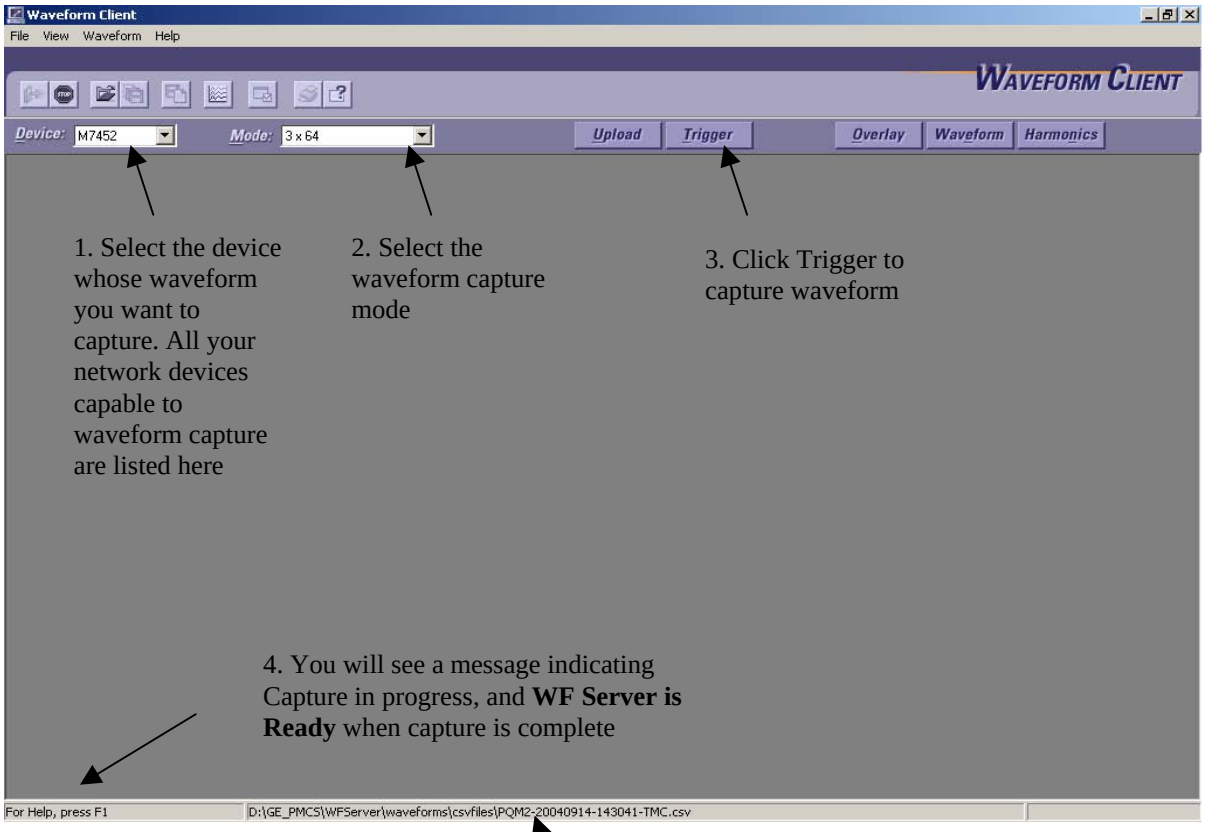
4. Capture a Waveform

Here's where you'll really learn to use the Waveform Capture Client–it's easy!

Select the device from which you want to capture a waveform, then select the waveform capture mode (see Chapter 3 for more information on modes). Now trigger the capture by clicking the **Trigger** button.

If you try to select a device and you haven't started the device's Server, the following error message is displayed:

If you see this message, click **Cancel** and make sure the WFServer (or GE 7700 Gateway Server) is running before you select a device in the WFClient, or go to **Configure** and select the proper WFServer that you wish to connect to.



There will be a pause while the waveform data is collected from the device[1], then you'll see the **WF Server Ready** message in the status bar at the bottom of the window. When you see this message, you're ready to display the

[1] The length of the pause while data is collected from a device depends on the complexity of the device involved. For some advanced power management devices such as the ALPS or LPS, the delay may be very long due to the size of the oscillography report - delays of up to 30 minutes are possible even under ideal operating conditions.

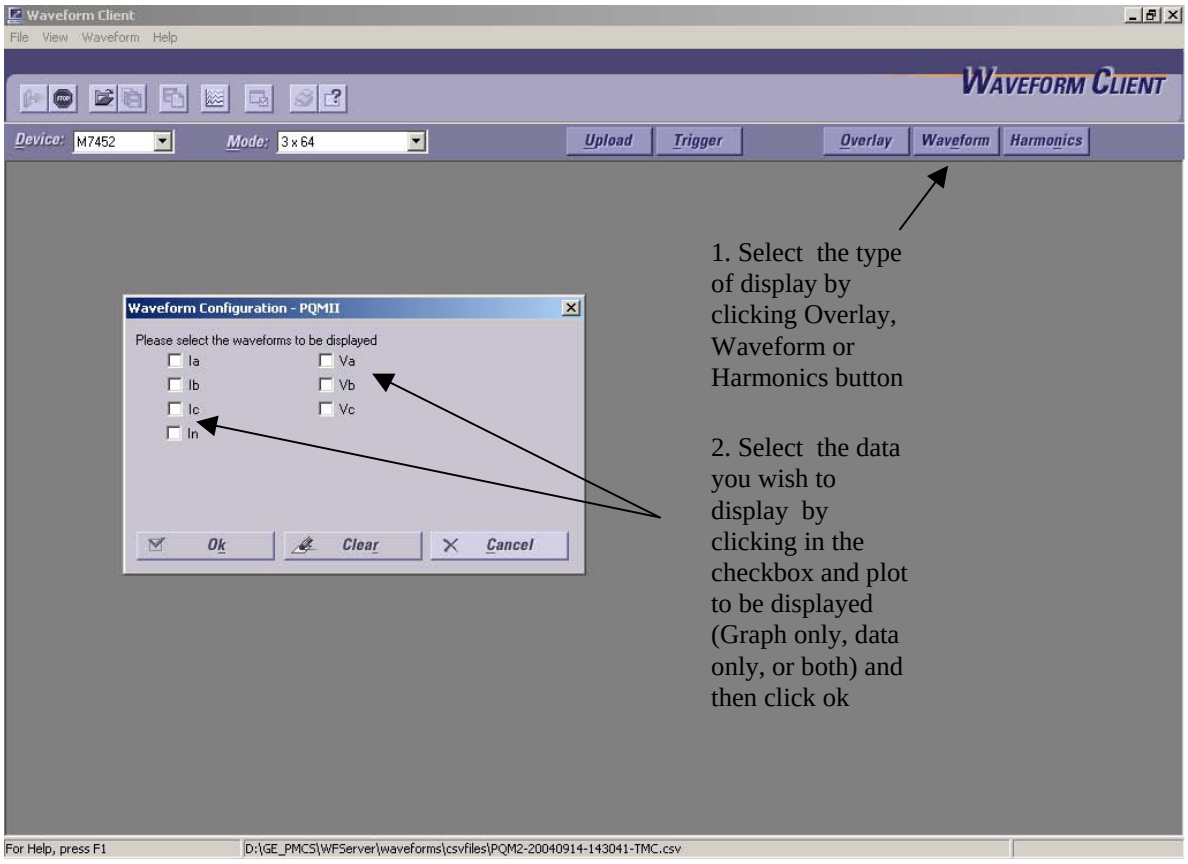
waveform data.

5. Display the Data

Select the type of display you want — Overlay, Waveform, or Harmonics. The Waveform Configuration window prompts you to select channels to plot.

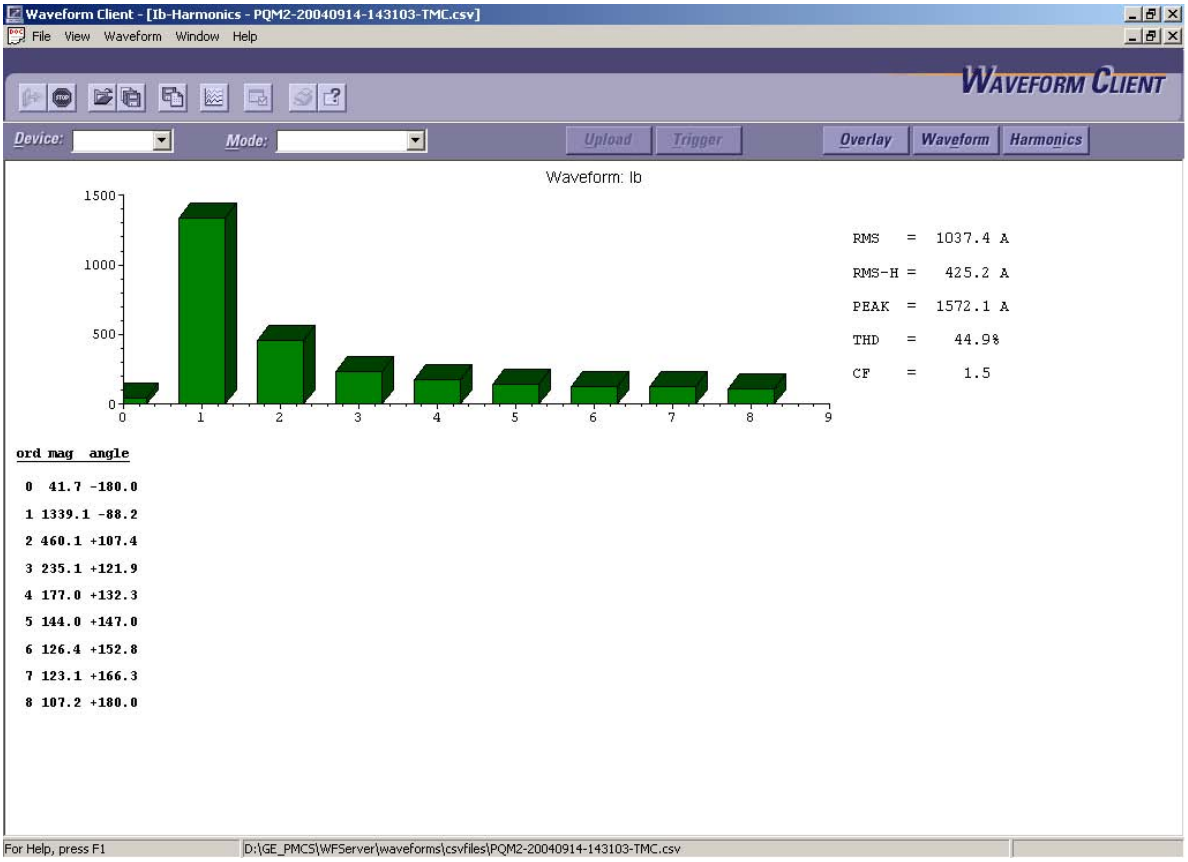
> Tip: For Harmonics displays, you can choose to plot the selected data in either a graph form, data-only form, or a window containing both a graph and the tabular data.

Click **OK** in the Waveform Configuration window and new windows will open showing your data plotted as you selected. Up to eight waveforms at a time may be displayed.



If you selected the **Waveform** or **Harmonics** button in step 1, you'll see a separate window displayed for each parameter you checked off in step 2. An example of this is shown below.

Some device types offer additional buttons in the Waveform Configuration window for selection of additional parameters to plot.



If you selected **Overlay** in step 1, a single window is opened, but it contains plots of all the parameters you checked off in step 2.

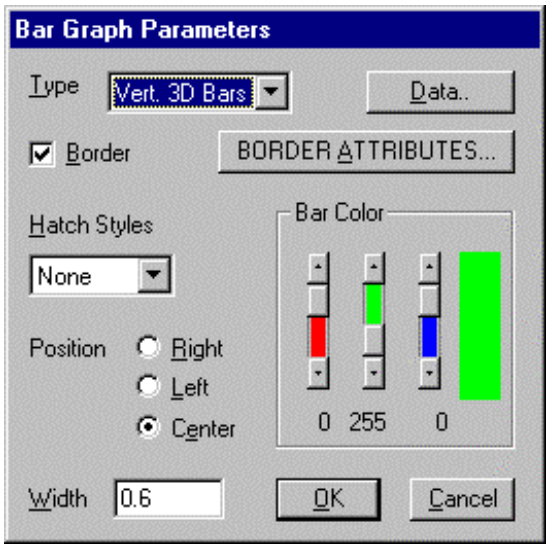
You can manipulate these windows in the standard 6.13 manner, minimizing or maximizing them, cascading or tiling them.

By default, the WFServer and GE 7700 Gateway Server each save retrieved waveforms in both COMTRADE and .csv (comma separated values) format with the device name, date, and time stamp embedded in the file name (see Chapter 3 for more information). You can disable COMTRADE format on a device-by-device basis if desired.

From WFClient, you can save captured waveform data under a different name, or save the current window as a Metafile graphics file for display in Microsoft Word or Power Point.

It is useful to note that although files are saved by the Server in both .csv and COMTRADE file formats (COMTRADE option can be disabled), WFClient *cannot* open a COMTRADE file. Only .csv and .wmf files can be opened by WFClient.

You can also customize the display of data in display windows by double-clicking on the graph itself. This presents a dialog box (shown below), containing the graph parameters, and enables you to customize the type of graph (bar, line, curve, etc.), the border and attributes, the hatch style, position, width, colors and other attributes, depending on the type of graph you select.



That completes our Quick Start for the Waveform Capture software. We recommend that you read the rest of this manual to gain a more thorough understanding of the software and its capabilities.

NetDDE Setup

Up until this point, we have assumed that the Waveform Capture Client is running on the same machine as the Waveform Capture Server. However, Waveform Capture offers the capability to run many Waveform Capture Clients on other, networked machines, all communicating with the same WFServer via NetDDE. NetDDE is a communications protocol allowing inter-application communication across a network, just as DDE allows communication between applications running on the same machine.

Note: If you are using DCOM communications instead of NetDDE, or if you will not be accessing the WFServer across the network, you do not need to read this section.

NetDDE requires a little extra setup. The WFServer must be *shared* to allow access over the network. The procedure to set up a share for WFServer is explained below in Manual NetDDE Setup. For more information on NetDDE and setting up shares, refer to GEH-6510, *PMCS DDE Server User's Guide*.

IMPORTANT: If you have installed the PMCS DDE Server, the NetDDE Share Utility (VNDDE.EXE) may already have set up the necessary shares. See GEH-6510 for details. VNDDE automates the process of setting up shares on 6.13. It is recommended over the manual process for speed and ease of use.

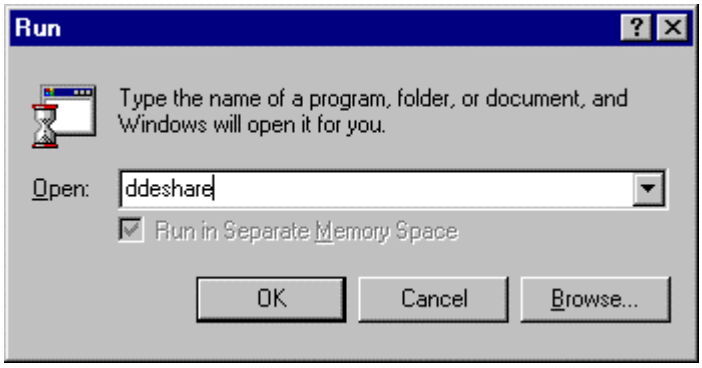
Manual NetDDE Setup

Use the DDE Share tool to manually set up the WFServer for sharing data across a network. DDE Share is a tool for managing DDE conversations over a network. With DDE Share, you can create, modify, and delete DDE shares so applications on one computer can share data with applications on other computers. You can also define security restrictions on DDE shares.

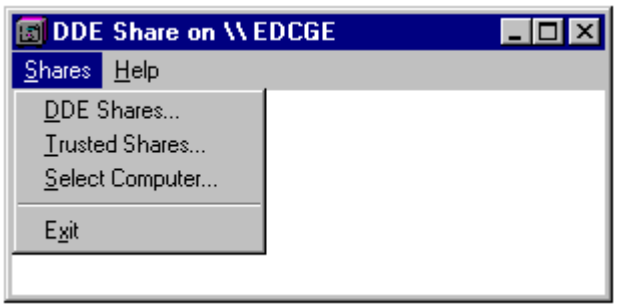
Follow the procedure outlined below to manually set up NetDDE.

1. On the Server computer, run DDESHARE.EXE (usually found in winnt\system32\ddeshare.exe). You can do this directly from the **Start**

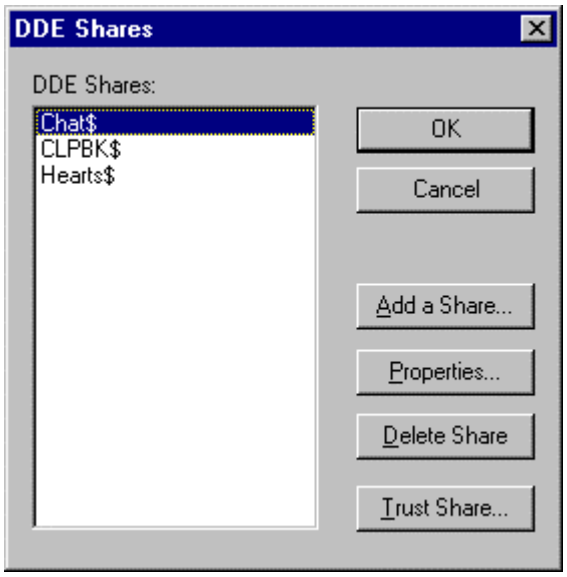
menu. Select **Run**, then type **ddeshare** and click **OK**, as shown in the following dialog box:



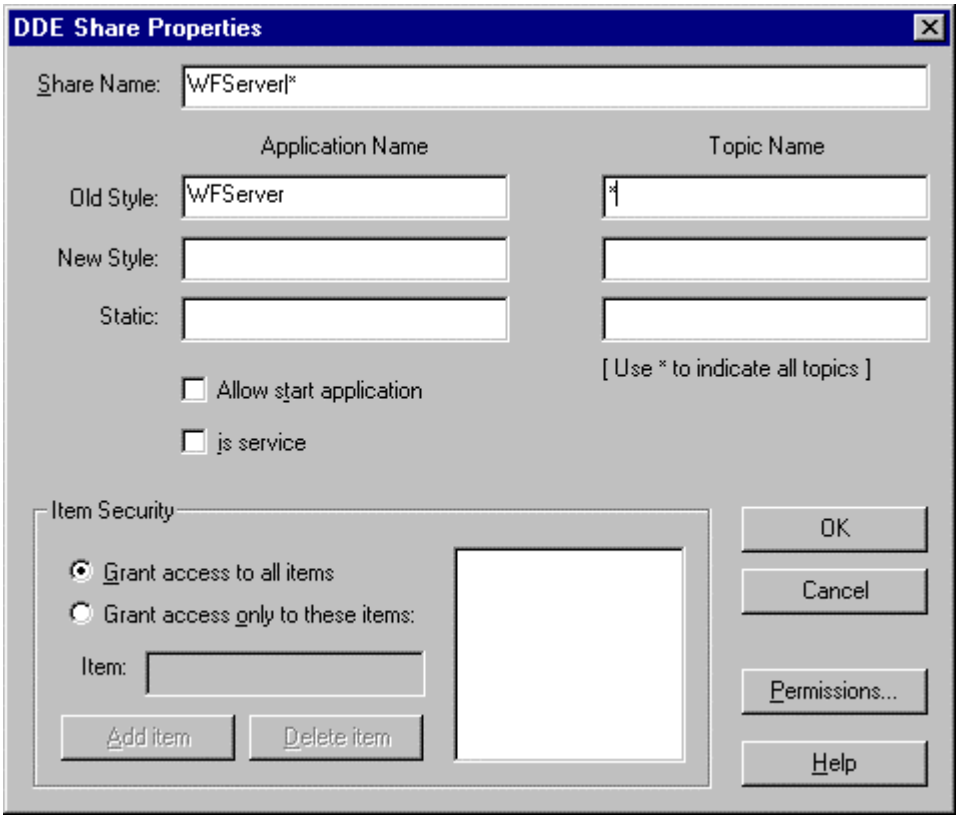
2. Select DDE Shares from the Shares menu:



3. The **DDE Shares** dialog box shows the available DDE Shares. Click **Add a Share...** to add a share name.



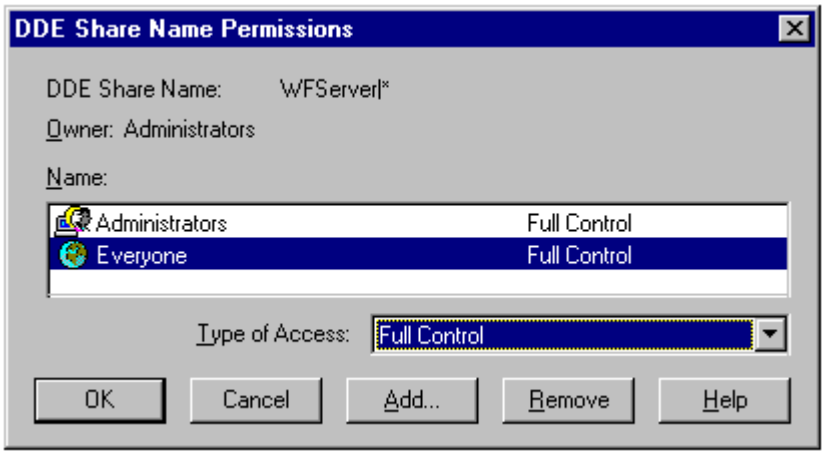
4. In the DDE Share Properties dialog box shown below, enter the share name as **WFServer|*.**



5. Enter the **Old Style Application Name** as WFServer and the Topic Name as *****. Leave the **New Style** and **Static** text fields blank.

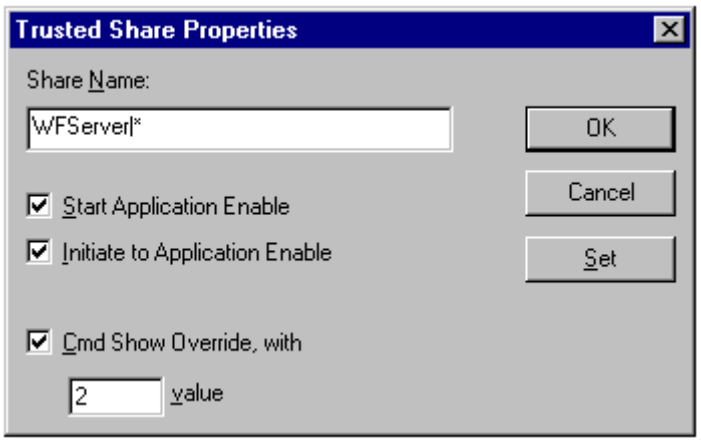
   Check the Allow start application checkbox, and select the Grant access to all items radio button.

   Click on the Permissions... push button. The Permissions dialog box is displayed:



6. Select **Everyone** and set **Type of Access** to **Full Control** (default is Read and Link). Close the **DDE Share Name Permissions** and **DDE Share Properties** dialog box.

7. Select **WFServer|*** from the **DDE Shares** dialog box and click the **Trust Share...** button; the **Trusted Share Properties** dialog box is displayed:



8. Set the options in the **Trusted Share Properties** dialog box to match those shown above, then click the **Set** button to accept the selected options, and the **OK** button to exit. You should be ready to access the Waveform Capture Server via NetDDE communications over your network.

Note: Beyond creating the WFServer DDE Shares as described in this section, for network access to work properly, the \GE_PMCS directory on the Waveform Server machine must be shared with full access permissions. This is normally done for you by the PMCS installer.

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WFClient

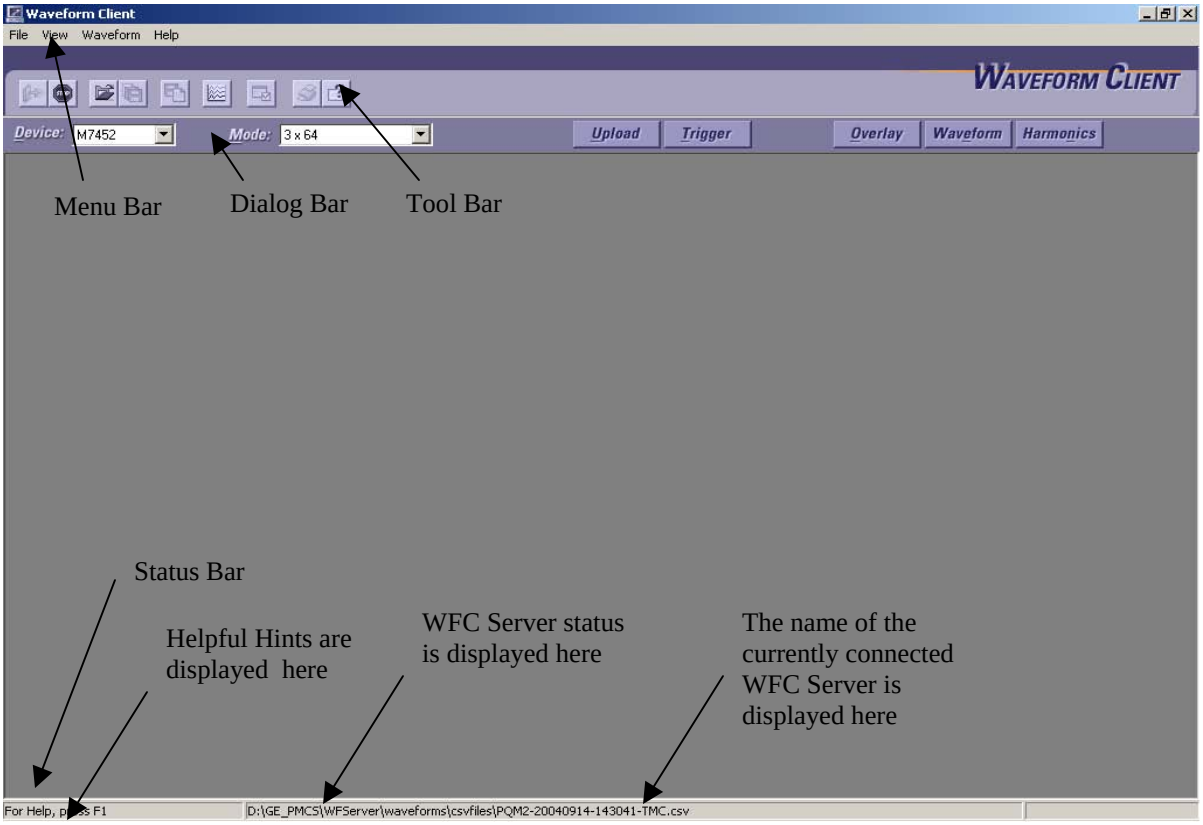
Introduction

As we have discussed in the previous sections, the Waveform Capture software consists of client and server pieces: WFClient collects and displays waveform data from the WFServer (for most PMCS devices) or the GE 7700 Gateway Server (services the EPM 7700, EPM 7600 and EPM 7500 device types). WFClient provides a user-friendly front-end to collect, display, and analyze waveforms retrieved from the WFServer, which gathers waveform data from the PMCS DDE Server on command or automatically, or from the GE 7700 Gateway Server, which collects data from the PML Comm Server, connected to the EPM 7700, EPM 7600 and EPM 7500 devices over Ethernet. While the WFServer and the PMCS DDE Server must be installed on the same PC, WFClient(s) may be located either on the same PC or on networked PCs, accessing the WFServer or GE 7700 Gateway via NetDDE (see Chapter 2, *Quick Start*, for information on setting up NetDDE).

(If you have not read the Theory of Operation section, please do so before continuing with this chapter.)

What's on the Waveform Capture Client Screen?

Your initial view of the WFClient program is the main window. It looks similar to this:



There are many helpful navigational and operational aids in the main window. Specific items to note:

- **Selectivity** – Push buttons and menu items are active only if the related objects and activities are available.

  ⇒ The **Save** menu items are active when any sub-window of the main window is open.

  ⇒ The **Overlay**, **Waveform**, and **Harmonics** buttons are active only when a waveform has been captured from a device or retrieved from a previously saved file.

- **Function access** – The following controls are available on the main window:

  ⇒ *Menu bar* – Located directly beneath the window's title bar. You can access these pull-down items either with the mouse or by standard alt+keystroke combinations.

  ⇒ *Toolbar* – Located directly beneath the menu bar. These control buttons provide quick access to frequently used functions.

  ⇒ *Dialog bar* – Located directly beneath the toolbar. These controls provide additional information and controls.

  ⇒ *Status bar* – Located along the lower edge of the window. This field displays messages identifying the WFServer currently connected, showing the current state of waveform capture activity, and providing helpful hints.

These controls are discussed in more detail in the following sections.

- **User Help** – Where applicable, **Tool Tips** appear below the cursor and in the status line at the bottom of the main window, prompting an action or describing an object when the cursor lingers over the object.

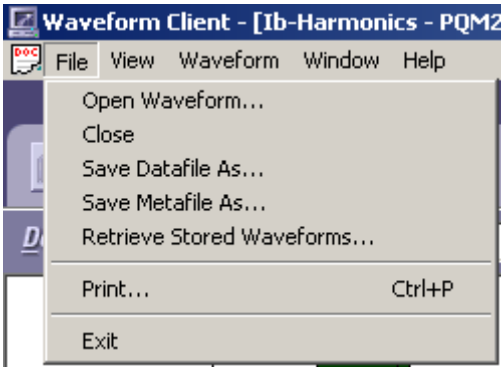
Menu Bar

The **Waveform Capture** main window contains the following pull-down menus:

Explanations of the menus and their options follow.

File Menu

The **File** pull-down menu is shown below. Descriptions of the File options follow.



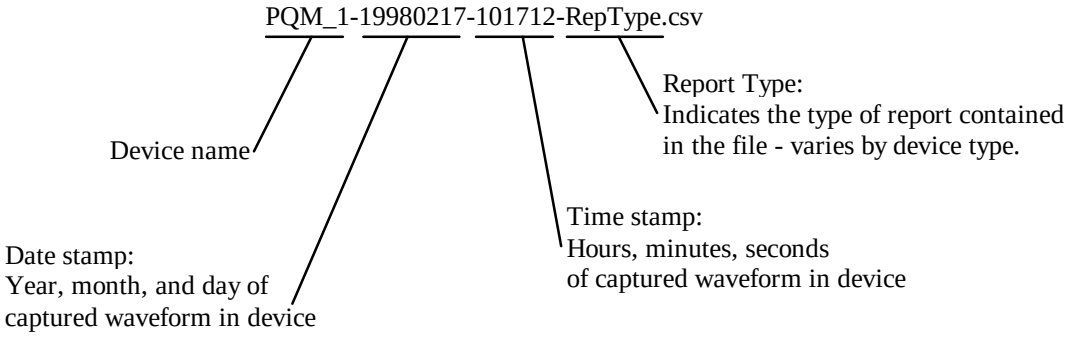
- **Open Waveform...** displays a standard **Open** dialog for retrieving a waveform that you previously saved and wish to reanalyze.
- **Save Datafile As...** displays a standard **Save As** dialog for saving a datafile to a specific location. The file is saved in comma-separated values (.csv) format.
- **Save Metafile As...** displays a standard **Save As** dialog for saving an image of the current window. The file is saved in Windows Metafile (.wmf) format for easy importing into applications such as Microsoft word for reports or Microsoft PowerPoint for presentations. No data is saved with a metafile; only a picture of the current window.
- **Retrieve Stored Waveforms** retrieves a previously stored waveform from the WFServer's **WFServer\Waveforms\CSVFiles** directory.
- **Exit** is the standard Windows function for closing the program.

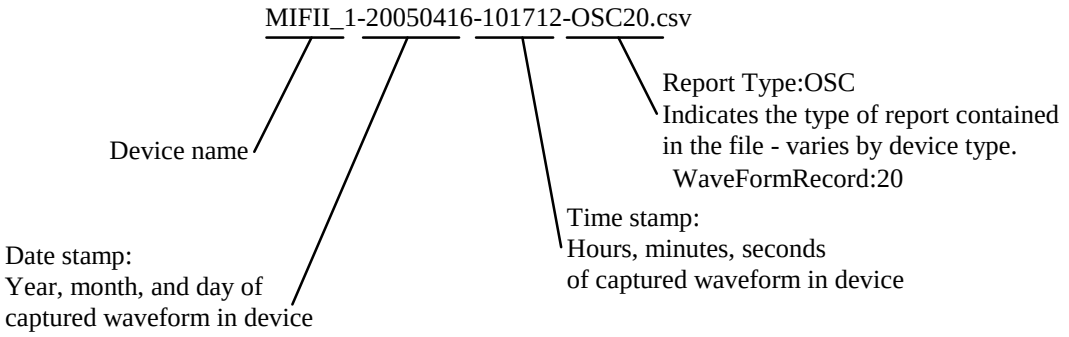
NOTE: As soon as a waveform is retrieved, it is saved to a .csv file. (See Chapter 5, *File Locations and Formats*, for more details.) This .csv file may be imported into Excel or other data analysis programs if desired. While viewing a datafile in the Waveform Capture Client, you can save any of the waveform graphs or harmonics screens as Metafiles. Metafiles are graphics useful for importing into reports or

embedding into e-mail, etc. IMPORTANT: Metafiles may not be resaved as Datafiles.

File Naming Conventions

The Waveform Capture Client saves files with a descriptive file name, for easy reference to the file's contents. A sample file name is shown below with a description of what it means.





Some device types support multiple waveform capture modes. RepType indicates the particular report type captured by a device. The valid report types are:

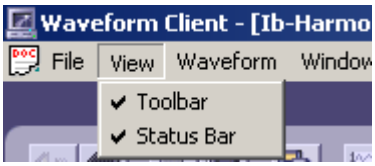
Report Types	Devices it applies to:
WFC	E3710, E3720, PLM
WFR	E3720, E7700, E7600, E7500
TMC	ML469, ML489, ML745, MLPQM, ML750, ML760, PQMII
OST	ALPS
OSC	ALPS, LPS, DFP100, DFP200, UR, EPM9450Q, EPM9650Q, EPM7450D, F650, ENTELLISYSLVS, MIFII
RMS	DFP200
THD	DFP200

For more details on different report types, refer to Waveform Capture Modes under the Mode Pull-Down List topic Table 3.

View Menu

The **View** pull-down menu is shown below. Descriptions of the **View** options

follow.

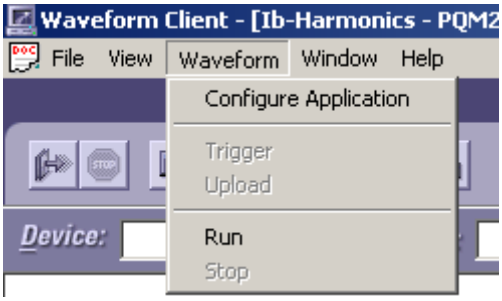


- **Toolbar** toggles (when checked or unchecked) display of the toolbar at the top of the main window.
- **Status Bar** toggles (when checked or unchecked) display of the status bar at the bottom of the main window.

NOTE: You may also attach the toolbar to the bottom or sides of the main window or float the toolbar within the main window. Select a spot on the toolbar (that is not a button) and drag the toolbar to the position of your choice.

Waveform Menu

The **Waveform** pull-down menu is shown below. Descriptions of the **Waveform** options follow.



- **Configure Application** opens the **Configure Application** dialog box. This window is used to select Servers applications for the WFClient to access. This option is available only when the Waveform Client application is in **Stop** mode (see **Run/Stop** below).
- **Trigger** issues a trigger command to the current device (the device whose name is shown in the **Device** pulldown list on the dialog bar) for the mode currently selected in the Mode pull-down list on the dialog bar. **Upload** attempts to retrieve a stored waveform from the selected device.
- **Run/Stop** causes the WF Client to start or stop communicating with its configured Server(s). These commands are mutually exclusive, and operate like an on/off switch for the client program's communications with its servers.

Waveform Menu ► Configure Application

The **Configure Application** window allows you to select the one or more Waveform Capture Servers or GE 7700 Gateway Servers to collect waveforms from. The WFClient consults with each Server selected, and keeps a list of the configured devices listed in each Server's registry. Waveform clients can connect to multiple waveform servers; different servers may use either the DDE or DCOM communications protocol, though a given server may only use one protocol or the other.

To fully understand how the PMCS DDE Server, WFServer (and/or GE 7700 Gateway Server), and WFClient relate, you may find the following explanation helpful:

1. The PMCS DDE Server is started. Its "System" topic becomes active, which contains details on all configured waveform capture-capable devices.

2. The WFServer is started. It locates the DDE Server and refers to the System topic for configuration information, including device (topic) names of all waveform capture-capable devices. It copies this list of devices to the WFServer file's registry. (In the case of the GE 7700 Gateway Server, the Gateway seeks out the PML Comm Server program for a list of EPM 7700, EPM 7600 and EPM 7500 devices.)

3. Finally, the WFClient software is started. It can be configured to access one or more WFServers or GE77GTWYs on local or remote workstations to obtain lists of available waveform capture-capable devices from which to obtain waveform data.

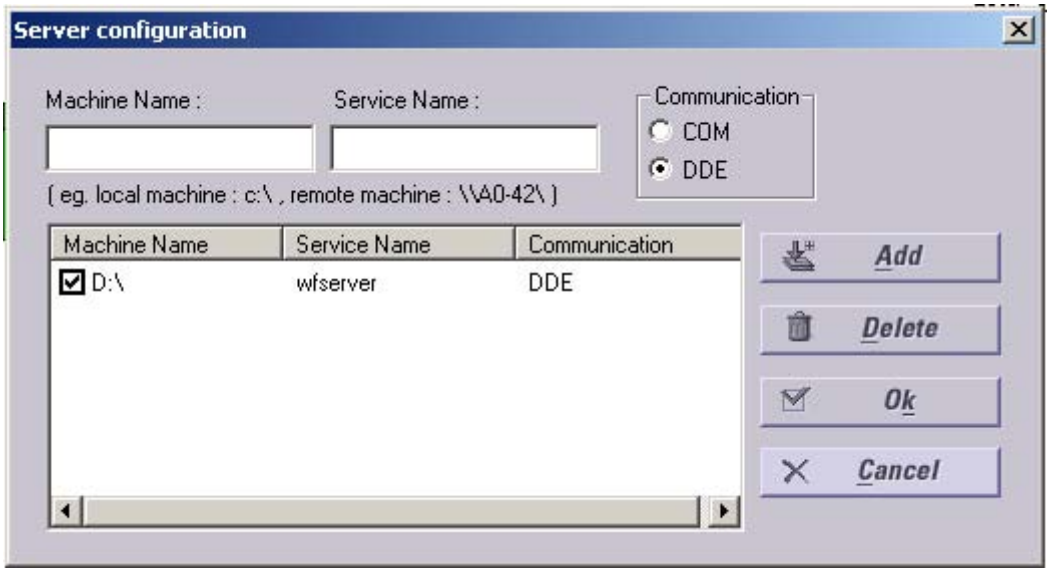
To add a WFServer to the WFClient's list, complete the Machine Name and Service Name fields, indicate the Communication protocol to use when contacting this server (typically DDE but choose COM if the Server is not located on the same subnet as the client; the COM option uses the Distributed Communications, or DCOM, protocol which is capable of communicating across network routers), then select the **Add** button. Remember that all the WFServers configured for a single WFClient must use the same communications protocol, either NetDDE or DCOM. NetDDE and DCOM may not be mixed at a single WFClient, except if NetDDE is being used to access a GE 7700 Gateway Server and DCOM is being used to access WFServer(s).

You must identify a server by the name of the machine on which it is located and by the service name (application name) of the Server program. The local machine is **'C:\'**, networked machines must be indicated by **'\\machinename\'**. Clicking the Add button adds the Server to the list of configured Servers. You may enable or disable individual servers by selecting or deselecting the checkbox to the left of each Server's name.

NOTE: If the WFServer or 7700 Gateway is being accessed over a network, you will need to access the Server application through the its complete network path rather than using a shortcut or shared network drive (for example, J:\). The name of a networked drive should have the format \\host_computer\c_drive\.

To remove a Server from the WFClient's list, select it from the list, then choose the **Delete** button.

When you are through adding or deleting Servers from the list, click **OK** to accept your changes or **Cancel** to exit without changing the list.



The screen shot above shows a local Waveform Capture Server has been configured, and a remote GE 7700 Gateway Server in the process of being configured.

This function may also be accessed by clicking the **Configure Application** button on the Toolbar.

Waveform Menu ▶ Trigger

Trigger captures waveform data from the current device, based on the mode selected in the **Mode** pulldown list.

A message appears in the status bar at the bottom of the main window indicating that waveform capture is in process, then indicates when the waveform capture has been completed. Once the waveform data has been captured, it may be viewed in various ways, which will be discussed later.

This function may also be performed by clicking the **Trigger** button on the Toolbar.

Waveform Menu ▶ Upload

Upload attempts to upload any captured waveform data from the current device. If no captured waveform is available to be uploaded, a dialog box notifies you of this.

This function may also be performed by clicking the **Upload** button on the Toolbar.

Waveform Menu ▶ Run/Stop

Run/Stop activate and deactivate the Waveform Capture Client's communications with any Servers, which have been configured. This function is analogous to the Waveform Capture Server's Run/Stop function, which establishes/breaks communications to the PMCS DDE Server and/or other DDE Servers.

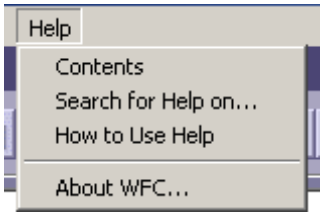
The Waveform Capture Client must be in Stop mode to access its Configuration functions.

Window Menu

The **Window** pull-down menu provides standard Windows functions for managing an applications windows.

Help Menu

The **Help** pull-down menu is shown below. The options are standard Windows functions.


Help
Contents
Search for Help on...
How to Use Help
About WFC...

Toolbar

This is the **Waveform Capture** main window toolbar:

Click on one of the buttons in the toolbar to perform the corresponding action described below in Table 2:

Icon	Function	Description
	Datafile Open	Opens a previously saved waveform (.csv file).
	Datafile Save As	Saves the current waveform to a .csv file.
	Metafile Save As	Saves the current waveform (.csv) as a Metafile (.wmf) for export to applications such as Microsoft Word or Microsoft PowerPoint.
	Retrieve Stored Waveform	Retrieves a previously stored waveform from a Server's **Waveforms\CSVFiles** directory.
	Print	Prints an image of the currently active window.
	Configure Application	Opens the configuration dialog window. You may add, delete, activate, or deactivate individual Servers for the Client to access.
	Help	Opens the help file for Waveform Capture.

Table 2. Waveform Capture Toolbar Icons.

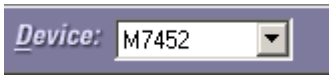
Dialog Bar

Use the **Waveform Capture** main window dialog bar (above) to:

- Select the current device for waveform capture and display;
- Select the waveform capture mode to be executed from the **Mode** pull-down list;
- Upload the last waveform capture from the selected device (**Upload** button);
- Trigger a waveform capture (**Trigger** button);
- Select display modes (**Overlay**, **Waveform**, **Harmonics**);

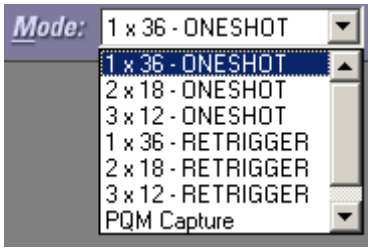
Device Pull-Down List

The **Device** pull-down list allows you to select the current device for waveform capture and display. It shows the current device being viewed and allows you to select from the list of devices that have been previously configured. To view recorded or captured waveforms from a device in the PMCS system, use the **Device** pull-down menu to select the appropriate device. The list contains devices from all configured WFServers or 7700 Gateways. Only one device may be selected at any given time.



Mode Pull-Down List

The **Mode** pull-down list shows the current mode of the waveform capture for the current device and allows you to select a mode for waveform capture. Each device has different waveform capture modes, so the **Mode** pull-down list will vary depending on which device is selected in the **Device** pull-down list.



NOTE: The Mode pulldown list is not available for the EPM 7700, EPM 7600 and EPM 7500, UR and F650 device types. Instead, the Waveform Client captures waveform data based on the mode selected at the EPM devices themselves. The mode may be set locally at the device itself or by using PMCS's EPM 7700, EPM 7600 or EPM 7500 wizard for EPM 7500, EPM 7600 and EPM 7700 devices, similarly using F650 PC program for F650 device. For information on the PMCS wizards, see GEH-6513 *PMCS Interface Toolkit (Wizard's Guide) for InTouch and*

Table 3 The table below lists the modes supported for each device and provides a brief description of what data is collected by each mode of waveform capture.

Device	Mode	Description
POWER LEADER Meter	PLM Capture	Total 128 samples for only one channel. 1 cycle at 128 samples/cycle in manual trigger mode (always Ia in manual trigger), 16 samples/cycle for 8 cycles in automatic trigger mode (only the phase current which went above the trip limit - Ia/Ib/Ic).
EPM 3710	E3710 Capture	Total 128 samples/channel, Voltage. 1 cycle at 128 samples/cycle. Only manual trigger mode.
EPM 3720	E3720 Capture	Total 128 samples/channel, Voltage V1 channel. 1 cycle at 128 samples/cycle. Auto Capture, Upload and Manual modes.
	E3720 1X36 Record	576 samples/channel, 8 channels. 36 cycles at 16 samples/cycle. Auto Capture, Upload and Manual modes.
	E3720 2X18 Record	288 samples/channel, 8 channels. 18 cycles at 16 samples/cycle. Auto Capture, Upload and Manual modes.
	E3720 3X12 Record	192 samples/channel, 8 channels. 12 cycles at 16 samples/cycle. Auto Capture, Upload and Manual modes.
Power Quality Meter (PQM)	1X36-ONESHOT[2]	7 Channels, 16 Samples per cycle and 36 cycles. Supports auto, manual and upload. One Shot doesn't support the cyclic capture. Once the device reaches the maximum number of waveforms for that mode, the device will capture no more until it is reset; that is the number of available waveforms is set to 0. This is called Rearming.
	2X18-ONESHOT	7 Channels, 16 Samples per cycle and 18 cycles. Supports auto, manual and upload.
	3X12-ONESHOT	7 Channels, 16 Samples per cycle and 12 cycles. Supports auto, manual and upload.
	1X36-RETRIGGER[3]	7 Channels, 16 Samples per cycle and 36 cycles. Supports auto, manual and upload. In this mode the device proceeds capturing the waveforms, even the maximum no. of waveforms for that mode is reached. It captures the new waveform using the buffer in the cyclic way.
	2X18- RETRIGGER	7 Channels, 16 Samples per cycle and 18 cycles. Supports auto, manual and upload.
	3X12- RETRIGGER	7 Channels, 16 Samples per cycle and 12 cycles. Supports auto, manual and upload.
	PQM Capture	7 Channels, 64 Samples per cycle. This is the parallel capture supported by the device. The number of samples per cycle or more to get better results. Supports manual and upload.
	High Speed Capture	7 Channels, 256 Samples per cycle. This is the parallel capture supported by the device. The number of samples per cycle or more to get better results. Supports manual and upload.
Power Quality Meter (PQMII)	1X36-ONESHOT[4]	7 Channels, 16 Samples per cycle and 36 cycles. Supports auto, manual and upload. One Shot doesn't support the cyclic capture. Once the device reaches the maximum number of waveforms for that mode, the device will capture no more until it is reset; that is the number of available waveforms is set to 0. This is called Rearming.
	2X18-ONESHOT	7 Channels, 16 Samples per cycle and 18 cycles. Supports auto, manual and upload.
	3X12-ONESHOT	7 Channels, 16 Samples per cycle and 12 cycles. Supports auto, manual and upload.
	1X36-RETRIGGER[5]	7 Channels, 16 Samples per cycle and 36 cycles. Supports auto, manual and upload. In this mode the device proceeds capturing the waveforms, even the maximum no. of waveforms for that mode is reached. It captures the new waveform using the buffer in the cyclic way.
	2X18- RETRIGGER	7 Channels, 16 Samples per cycle and 18 cycles. Supports auto, manual and upload.

[2] One Shot doesn't support the cyclic capture. Once the device reaches the maximum number of waveforms for that mode, the device will capture no more until it is reset; that is the number of available waveforms is set to 0. This is called Rearming.
[3] In this mode the device proceeds capturing the waveforms, even the maximum no. of waveforms for that mode is reached. It captures the new waveform using the buffer in the cyclic way.
[4] One Shot doesn't support the cyclic capture. Once the device reaches the maximum number of waveforms for that mode, the device will capture no more until it is reset; that is the number of available waveforms is set to 0. This is called Rearming.
[5] In this mode the device proceeds capturing the waveforms, even the maximum no. of waveforms for that mode is reached. It captures the new waveform using the buffer in the cyclic way.

Device	Mode	Description
	3X12- RETRIGGER	7 Channels, 16 Samples per cycle and 12 cycles. Supports auto, manual and upload.
	PQMII Capture	7 Channels, 64 Samples per cycle. This is the parallel capture supported by the device. The number of samples per cycle or more to get better results. Supports manual and upload.
	High Speed Capture	7 Channels, 256 Samples per cycle. This is the parallel capture supported by the device. The number of samples per cycle or more to get better results. Supports manual and upload.
SR750/SR760	2X128	10 Channels, 16 Samples per cycle and 128 cycles. Supports auto, manual and upload.
	4X64	10 Channels, 16 Samples per cycle and 64 cycles. Supports auto, manual and upload.
	8X32	10 Channels, 16 Samples per cycle and 32 cycles. Supports auto, manual and upload.
	16X16	10 Channels, 16 Samples per cycle and 16 cycles. Supports auto, manual and upload.
SR760	M760 2X2048 Trace	2048 samples/channel, 11 channels (2 of which are bit packed discrete input/output channels). 128 cycles, 16 samples/cycle. Manual and Auto modes supported.
	M760 4X1024 Trace	1024 samples/channel, 11 channels (2 of which are bit packed discrete input/output channels). 64 cycles, 16 samples/cycle. Manual and Auto modes supported.
	M760 8X512 Trace	512 samples/channel, 11 channels (2 of which are bit packed discrete input/output channels). 32 cycles, 16 samples/cycle. Manual and Auto modes supported.
	M760 16X256 Trace	256 samples/channel, 11 channels (2 of which are bit packed discrete input/output channels). 16 cycles, 16 samples/cycle. Manual and Auto modes supported.
SR745	3 x 64	14 Channels, 64 Samples per cycle and 64 cycles. Supports auto, manual and upload
SR469 and SR489	1 x 64	10 Channels, 12 Samples per cycle and 64 cycles. Supports auto, manual and upload
	2 x 42	10 Channels, 12 Samples per cycle and 42 cycles. Supports auto, manual and upload
	3 x 32	10 Channels, 12 Samples per cycle and 32 cycles. Supports auto, manual and upload
	4 x 25	10 Channels, 12 Samples per cycle and 25 cycles. Supports auto, manual and upload
	5 x 21	10 Channels, 12 Samples per cycle and 21 cycles. Supports auto, manual and upload
	6 x 18	10 Channels, 12 Samples per cycle and 18 cycles. Supports auto, manual and upload
	7 x 16	10 Channels, 12 Samples per cycle and 16 cycles. Supports auto, manual and upload
	8 x 14	10 Channels, 12 Samples per cycle and 14 cycles. Supports auto, manual and upload
	9 x 12	10 Channels, 12 Samples per cycle and 12 cycles. Supports auto, manual and upload
	10 x 11	10 Channels, 12 Samples per cycle and 11 cycles. Supports auto, manual and upload
	11 x 10	10 Channels, 12 Samples per cycle and 10 cycles. Supports auto, manual and upload
	12 x 9	10 Channels, 12 Samples per cycle and 9cycles. Supports auto, manual and upload
	13 x 9	10 Channels, 12 Samples per cycle and 9 cycles. Supports auto, manual and upload
	14 x 8	10 Channels, 12 Samples per cycle and 8 cycles. Supports auto, manual and upload
	15 x 8	10 Channels, 12 Samples per cycle and 8 cycles. Supports auto, manual and upload
	16 x 7	10 Channels, 12 Samples per cycle and 7 cycles. Supports auto, manual and upload
EPM 7700, EPM 7600 and EPM 7500	Regular Oscillography	Automatic and manual. 7 data channels. Number of cycles (and consequently number of samples) is dependent on device setting: Mode / Samples/Cycle / Number of Cycles / Samples/Channel 128x14 / 128 / 14 / 1792 64x14 / 64 / 14 / 896 64x28 / 64 / 28 / 1792 32x12 / 32 / 12 / 384 32x26 / 32 / 26 / 832 32x40 / 32 / 40 / 1280 32x54 / 32 / 54 / 1728 16x22 / 16 / 22 / 352 16x48 / 16 / 48 / 768 16x72 / 16 / 72 / 1152 16x96 / 16 / 96 / 1536 ***NOTE:*** The Oscillography mode cannot be selected by the Waveform Client's Mode pulldown menu. Instead, the Waveform Client captures waveform data based on the mode selected at the device itself. The mode may be set locally at the device itself or by using PMCS's EPM 7700, EPM 7600 or EPM 7500 wizard. For information on the PMCS wizards, see *GEH-6513* PMCS *Interface Toolkit (Wizard's Guide)* for InTouch and

Device	Mode	Description
		DEH-210 PMCS *Interface Toolkit (Wizard's Guide)* for Cimplicity.
UR	Regular Oscillography	Automatic and manual. 7 data channels. Number of cycles (and consequently number of samples) is dependent on UR modules installed and device setting: Mode / Samples/Cycle / Number of Cycles / Samples/Channel 1 x 144 / 1 / 144 / 144 2 x 108 / 2 / 108 / 216 3 x 86.1 / 3 / 86.1 / 258.3 4 x 71.8 / 4 / 71.8 / 287.2 5 x 61.5 / 5 / 61.5 / 307.5 6 x 53.8 / 6 / 53.8 / 322.8 7 x 47.9 / 7 / 47.9 / 335.3 8 x 43 / 8 / 43 / 344 9 x 39.1 / 9 / 39.1 / 351.9 10 x 35.9 / 10 / 35.9 / 359 11 x 33.1 / 11 / 33.1 / 364.1 12 x 30.8 / 12 / 30.8 / 369.6 13 x 28.6 / 13 / 28.6 / 371.8 14 x 26.9 / 14 / 26.9 / 376.6 15 x 25.3 / 15 / 25.3 / 379.5 16 x 23.9 / 16 / 23.9 / 382.4 17 x 22.6 / 17 / 22.6 / 384.2 18 x 21.5 / 18 / 21.5 / 387 19 x 20.5 / 19 / 20.5 / 389.5 20 x 19.5 / 20 / 19.5 / 390 21 x 18.6 / 21 / 18.6 / 390.6 22 x 17.9 / 22 / 17.9 / 393.8 23 x 17.1 / 23 / 17.1 / 393.3 24 x 16.5 / 24 / 16.5 / 396 25 x 15.9 / 25 / 15.9 / 397.5 26 x 15.3 / 26 / 15.3 / 397.8 27 x 14.8 / 27 / 14.8 / 399.6 28 x 14.3 / 28 / 14.3 / 400.4 29 x 13.9 / 29 / 13.9 / 403.1 30 x 13.4 / 30 / 13.4 / 402 31 x 13 / 31 / 13 / 403 32 x 12.6 / 32 / 12.6 / 403.2 33 x 12.3 / 33 / 12.3 / 405.9 34 x 11.9 / 34 / 11.9 / 404.6 35 x 11.6 / 35 / 11.6 / 406 36 x 11.3 / 36 / 11.3 / 406.8 37 x 11 / 37 / 11 / 407 38 x 10.8 / 38 / 10.8 / 410.4 39 x 10.4 / 39 / 10.4 / 405.6 40 x 10.1 / 40 / 10.1 / 404 41 x 10 / 41 / 10 / 410 42 x 9.75 / 42 / 9.75 / 409.5 43 x 9.5 / 43 / 9.5 / 408.5 44 x 9.25 / 44 / 9.25 / 407 45 x 9.13 / 45 / 9.13 / 410.85 46 x 8.88 / 46 / 8.88 / 408.48 47 x 8.75 / 47 / 8.75 / 411.25 48 x 8.5 / 48 / 8.5 / 408 49 x 8.38 / 49 / 8.38 / 410.62 50 x 8.25 / 50 / 8.25 / 412.5 51 x 8 / 51 / 8 / 408 52 x 7.88 / 52 / 7.88 / 409.76 53 x 7.75 / 53 / 7.75 / 410.75 54 x 7.63 / 54 / 7.63 / 412.02 55 x 7.5 / 55 / 7.5 / 412.5 56 x 7.38 / 56 / 7.38 / 413.28 57 x 7.25 / 57 / 7.25 / 413.25 58 x 7.13 / 58 / 7.13 / 413.54 59 x 7 / 59 / 7 / 413 60 x 6.88 / 60 / 6.88 / 412.8 61 x 6.75 / 61 / 6.75 / 411.75

<table>
<tr><th>Device</th><th>Mode</th><th>Description</th></tr>
<tr><td></td><td></td><td>62 x 6.63 62 6.63 411.06
63 x 6.5 63 6.5 409.5
64 x 6.5 64 6.5 416
NOTE: The Oscillography mode cannot be selected by the Waveform Client's Mode pulldown menu. Instead, the Waveform Client captures waveform data based on the mode selected at the UR device itself. The mode may be set locally at the device itself or by using PMCS's UR wizard. For information on the PMCS wizards, see GEH-6513 PMCS Interface Toolkit (Wizard's Guide) for InTouch and DEH-210 PMCS Interface Toolkit (Wizard's Guide) for Cimplicity..</td></tr>
<tr><td>EPM7450D</td><td>EPM7450D Record</td><td>Sample Rate (Samples/Cycle) (Set at Device) | Type | Channels | Samples/Channel
16 | ---- | Ia, Ib, Ic, Van, Vbn, Vcn | 960</td></tr>
<tr><td>EPM9450Q</td><td>EPM9450Q Record</td><td>Sample Rate (Samples/Cycle) (Set at Device) | Type | Channels | Samples/Channel
16 | --- | Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital | 1024
32 | --- | Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital | 1024
64 | --- | Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital | 1024
128 | --- | Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital | 1024
256 | 0 | Va, Vb, Vc 8 Digital | 2048
1 | Ia, Ib, Ic 8 Digital
512 | 0 | Va, 8 Digital | 4096
1 | Vb, 8 Digital
2 | Vc, 8 Digital
3 | None
4 | Ia, 8 Digital
5 | Ib, 8 Digital
6 | Ic, 8 Digital
7 | Inm, 8 Digital</td></tr>
</table>

<table>
<tr><th>Device</th><th>Mode</th><th>Description</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>EPM9650Q</td><td>EPM9650Q Record</td><td>
<table>
<tr><th>Sample Rate (Samples/Cycle) (Set at Device)</th><th>Type</th><th>Channels</th><th>Samples/Channel</th></tr>
<tr><td>16</td><td>---</td><td>Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital</td><td>1024</td></tr>
<tr><td>32</td><td>---</td><td>Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital</td><td>1024</td></tr>
<tr><td>64</td><td>---</td><td>Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital</td><td>1024</td></tr>
<tr><td>128</td><td>---</td><td>Va, Vb, Vc, Ia, Ib, Ic, Inm 8 Digital</td><td>1024</td></tr>
<tr><td>256</td><td>0
1</td><td>Va, Vb, Vc 8 Digital
Ia, Ib, Ic 8 Digital</td><td>2048</td></tr>
<tr><td>512</td><td>0
1
2
3
4
5
6
8</td><td>Va, 8 Digital
Vb, 8 Digital
Vc, 8 Digital
None
Ia, 8 Digital
Ib, 8 Digital
Ic, 8 Digital
Inm, 8 Digital</td><td>4096</td></tr>
</table>
</td></tr>
<tr><td>F650</td><td>Regular Oscillography</td><td>Automatic and manual. Contains 9 fixed analog channels and 16 configurable digital channels. Number of samples / cycle (consequently, number of cycles) and maximum number of oscillography records (consequently, number of samples) can be configured in the device settings:
Maximum Number of Oscillos (Max. Number Osc.): 1 to 20 oscillography records can be selected.

The capacity of each record will depend on the capacity = 1Mbyte / Max. Number Osc. For example, for a Max. Number Osc. of 4,

each record will store 1Mbyte / 4 = 262144 bytes.

This capacity is divided in 9 measures * 4 bytes/measure + 2 digital bytes = 38 bytes per stored sample.

For this example, the number of samples per oscillography record is 262144 bytes / 38 bytes = 6898 samples per stored oscillo.</td></tr>
</table>

<table>
<tr><th>Device</th><th>Mode</th><th>Description</th></tr>
<tr><td></td><td></td><td>
Trigger Position: (5 %– 95%) This setting defines the prefault amount (in percentage) stored every time a new oscillo is produced.

Samples/Cycle: (4 – 8 - 16 - 32 - 64).This setting defines the number of samples per cycle stored in each oscillography record.

Back to the previous example, if we set the relay to 64 samples per cycle, each record will store up to 6898 / 64 = 107.78 signal cycles. This value expressed in terms of time would be:

For 50 Hz: 107.78 cycles x 20 ms/cycle = 2.155 seconds.

For 60 Hz: 107.78 cycles x 16.67 ms/cycle = 1.796 seconds.

<table>
<tr><th>Max. No. Of Oscillography Records</th><th>Samples / Cycle</th></tr>
<tr><td>1 - 20</td><td>4</td></tr>
<tr><td>1 - 20</td><td>8</td></tr>
<tr><td>1 - 20</td><td>16</td></tr>
<tr><td>1 - 20</td><td>32</td></tr>
<tr><td>1 - 20</td><td>64</td></tr>
</table>

Automatic Overwrite: (Enabled / Disabled) This setting allows chained oscillographies during the fault (TRIGGER OSCILLO signal activation). The maximum allowed value to be stored as a chained oscillography is 1 Mbyte. In this case, even if the trip continues during a time longer than the associated to 1 Mbyte of memory, the relay will stop storing oscillography in RAM memory until the complete record has been saved in non-volatile memory. The oscillography module will be reset once the Mbyte has been completely stored in Flash memory and the TRIGGER OSCILLO state is deactivated.

NOTE: The Oscillography mode (Maximum no of oscillography records, samples / cycle, trigger Position, Automatic Overwrite Settings) cannot be selected by the Waveform Client's Mode pull down menu. Instead, the Waveform Client captures waveform data based on the settings selected at the F650 device itself. These settings may be set locally at the device itself or by using F650 PC Program.
</td></tr>
<tr><td>MIFII</td><td>Oscillography</td><td>
Automatic and manual. Contains 4 analog channels and 40 digital channels.

Analog Channels:
Instantaneous values of phase (Ia, Ib, Ic) and ground (IN) currents.
Digital Channels:
Pickups (protection functions1)
Trip inhibition by digital input (protection functions1)
Trips (protection functions1)
Ready (protection in service)
Auxiliary digital outputs
Digital inputs
Breaker 52A, Breaker 52B, (status of the digital inputs)
Status 52 (status of the circuit breaker) (only OPTION 2 models)
Breaker opening failure (only OPTION 2 models)
I2 alarm (only OPTION 2 models)
Cold load pickup (only OPTION 2 models)
Group 2 selection by digital input
EEPROM failure
Default settings/User settings

1→ Protection functions: 50P1, 50P2, 50G1, 50G2, 51P, 51G, 49, general

OPTION 1: MIFIIP***E1**00
</td></tr>
</table>

Device	Mode	Description
		OPTION 2: MIFIIP***E2**00 Maximum number of oscillography records = 1 and number of samples = No of Pre-fault cycles = 2 Samples/Cycle: 8. Number of cycles = 24 including 2 pre-fault cycles.
EntellisysLVS	Oscillography	Automatic and manual. Contains 7 analog channels and 9 digital channels in each node. Maximum of 30 nodes can be commissioned. Analog Channels: Ia, Ib, Ic, In, Va, Vb, Vc or Vab, Vbc, Vca Digital Channels: Open Command Trip Command Close Command Open Status Closed Status Spring Charged Status Analog IOC Status Backup Trip Flag Status Node Sync Status Maximum number of oscillography records will be dependent on the number of nodes commissioned and number of waveform buffers free to accommodate the new waveform. Total Number of waveform buffers = 1000. For example, when a waveform is generated with 10 nodes installed and commissioned, the waveform will take 10 buffers to save. No of Pre-fault cycles = This can be configured between o to 119 half cycles using EntellisysLVS HMI. **Automatic Overwrite: (Enabled / Disabled)** This setting allows chained oscillographies during the fault (TRIGGER OSCILLO signal activation). The maximum allowed value to be stored as a chained oscillography is 1000 buffers. In this case, even if the trip continues during a time longer than the associated to 1000 buffers of memory, the relay will stop storing oscillography in RAM memory until the complete record has been saved in non-volatile memory. The oscillography module will be reset once the 1000 buffers has been completely stored in Flash memory and the TRIGGER OSCILLO state is deactivated

Table 3. Waveform capture modes.

Note: Any mode that captures more than 128 samples/cycle are not recommended for harmonic analysis with Waveform Analyst, Waveform Client and PQ Analyst. Erroneous results may be reported.

Upload Button

Upload allows you to retrieve the all the available waveforms in the currently selected device. (Upload is not supported by the Power Leader Meter and the EPM 3710 device types.)

Trigger Button

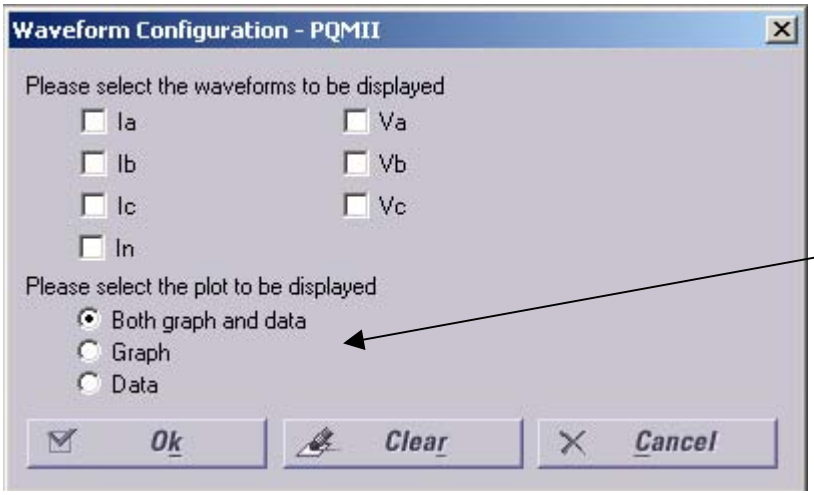
Trigger allows you to manually capture a waveform from the selected device and

re-arm the device when you have completed viewing the waveforms and are ready for another capture or record.

The **Trigger** button is disabled if the currently selected device does not support manual waveform capture, or when the device is off-line due to a communications failure. Manual trigger is not supported for F650, hence the trigger button will be disabled when F650 device type is selected.

Overlay, Waveform, Harmonics Buttons

Once a waveform has been captured, these three buttons allow you to select which data is plotted on screen. Clicking Overlay, Waveform, or Harmonics displays the Waveform Capture window for selection of data channels to be displayed.



Select Plot is available for Harmonics display only. Choose the type of the plot by selecting a radio button

The **Waveform Configuration** dialog offers check boxes for each channel of data available from a particular device. Some device types offer additional buttons to access more channels of data. Click in the check boxes for each channel of data you'd like to see displayed, then click **OK**.

NOTE: A maximum of eight channels may be selected for display. In some cases where only one channel of data is available for display, the **Waveform Configuration** dialog box will not be displayed at all. The display window for the one available channel of data will be displayed immediately. Also, in cases in which only one channel of data is available for display, the **Overlay** button is disabled, as it has no function unless there are two or more channels of data.

Individual windows will be opened for each parameter you've selected. In the case of the **Overlay** button, only one window is opened and all selected parameters are plotted in this one window.

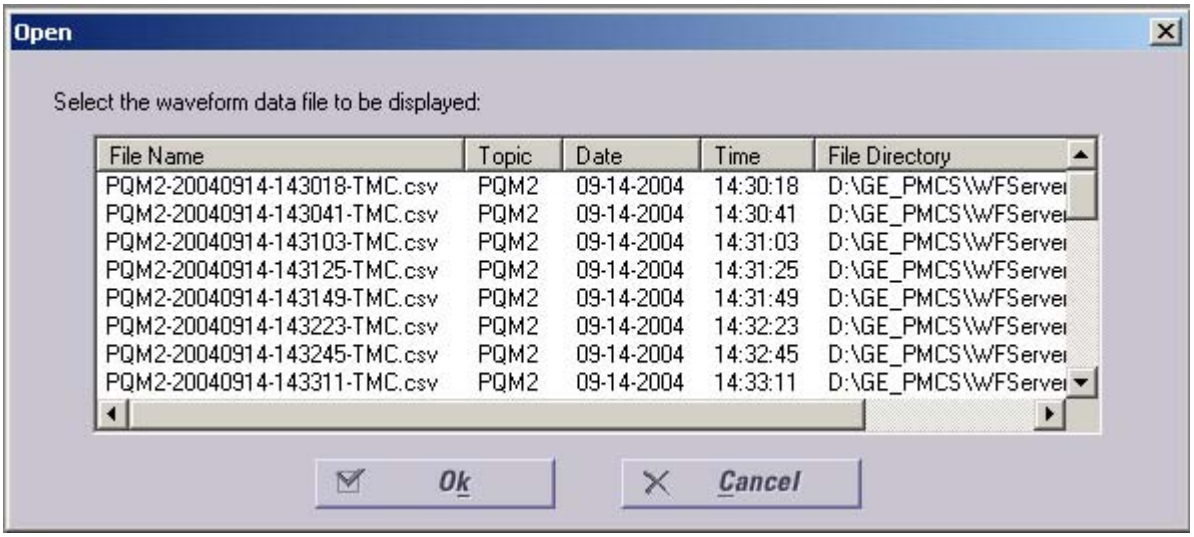
Harmonics displays contain a variety of data including the following:

- The harmonic order, harmonic magnitude as a percentage of the fundamental, and the phase angle, reported up to the 64th harmonic (as applicable).
- **RMS =** The square root of the mean of the squared waveform samples.

- **RMS-H =** The peak harmonic values (ignoring dc and the fundamental) squared, summed, and square rooted.
- **PEAK =** The peak voltage or current.
- **THD (Total harmonic Distortion) =** The sum of the magnitudes of the signal harmonics (excluding dc and the fundamental) divided by the magnitude of the fundamental, multiplied by 100.
- **CF (Crest Factor) =** The absolute peak divided by the RMS.
- Harmonics displays do not allow channel selection for discrete data (e.g., digital inputs and outputs). For ALPS and LPS device types, harmonics is disabled if data is discontinuous or contains bad or missed samples.

Retrieve Button

The **Retrieve** button allows you to open waveform files saved to disk by either manual or automatic waveform retrieval.



The **Open** dialog box is displayed, listing the file name, topic (device), and date and time stamp of the waveforms on file. The last column lists the directory where the file is located, enabling you to determine which WFServer or GE 7700 Gateway Server the device is connected to. This is useful if you have configured your client for multiple Servers.

Select the desired waveform and click **OK**. You may then view and manipulate the data as you wish.

Minimize Icon

The following icon appears when the Waveform Capture application is minimized.

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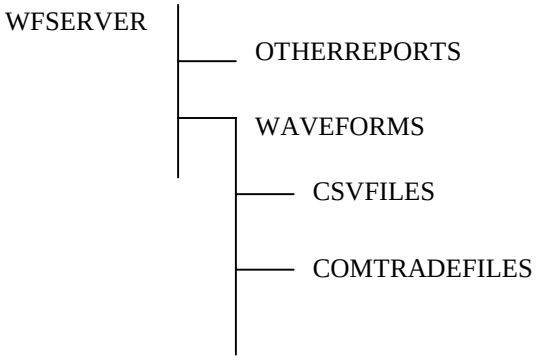
File Locations and Formats

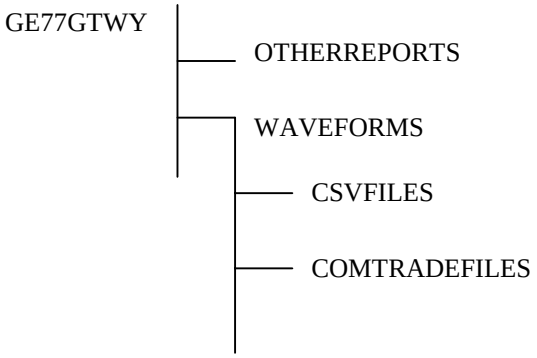
File Storage Locations

By default, PMCS Waveform Capture Server saves retrieved waveform data to disk in both COMTRADE and .CSV (comma-separated value) format.

The default file location directory structure is:



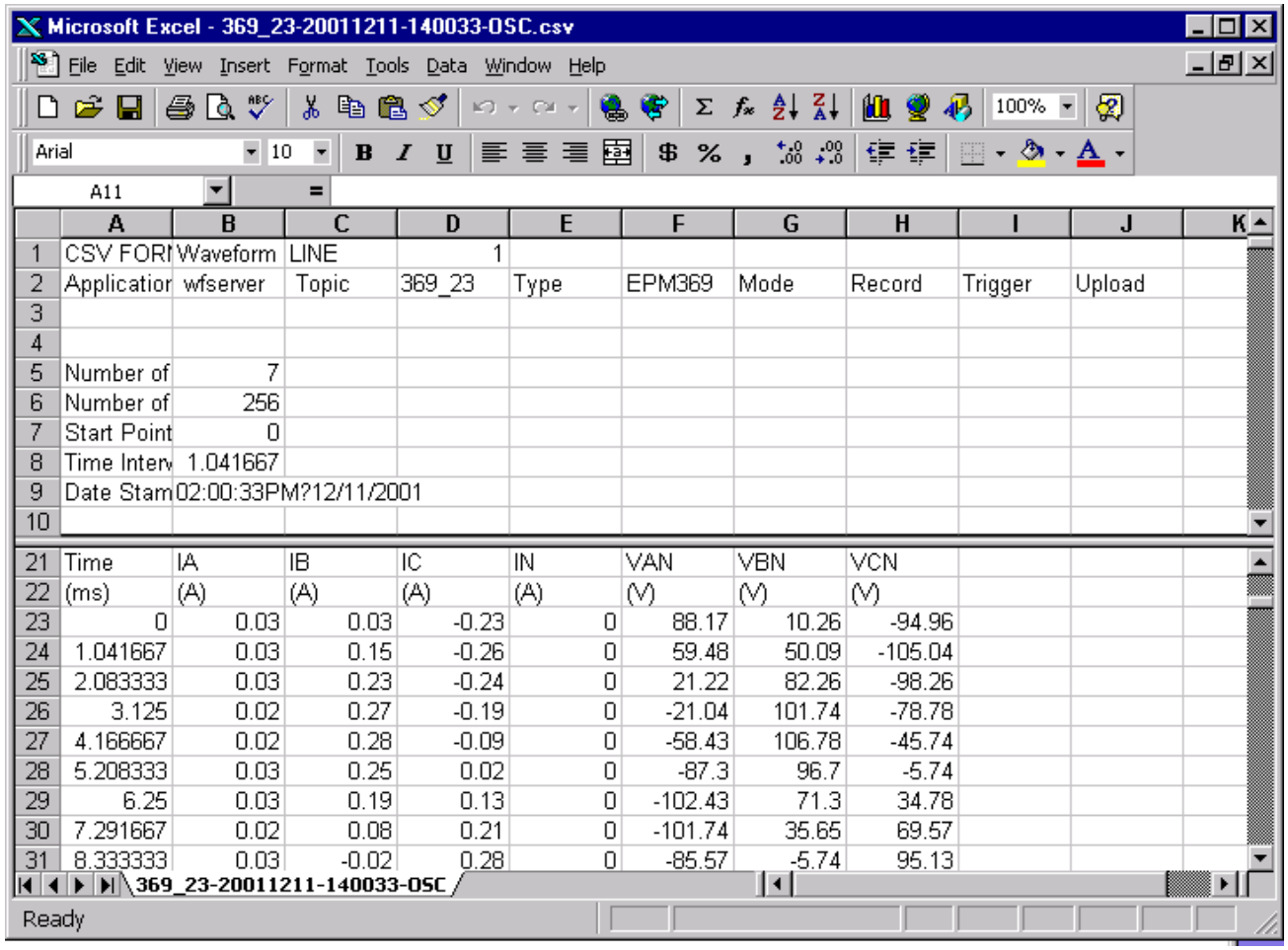
The EPM 7700 Gateway saves retrieved waveform data to disk in an equivalent directory structure:



NOTE: It is important to remember that although WFClient can display .csv or .wmf files and can save a .csv file as a .wmf file format, it cannot display or "Save As…" in COMTRADE format. The COMTRADE format is written to disk only. Commercially available COMTRADE viewers may be used to analyze these datafiles.

Data File (.csv) Imported into Microsoft Excel

The picture below shows a waveform capture data file (.csv file format) imported into Microsoft Excel for data analysis and manipulation.



Microsoft Excel - 369_23-20011211-140033-OSC.csv

File Edit View Insert Format Tools Data Window Help

Arial 10 100%

A11 =

	A	B	C	D	E	F	G	H	I	J	K
1	CSV FORI	Waveform	LINE	1							
2	Applicatior	wfserver	Topic	369_23	Type	EPM369	Mode	Record	Trigger	Upload	
3											
4											
5	Number of	7									
6	Number of	256									
7	Start Point	0									
8	Time Interv	1.041667									
9	Date Stam	02:00:33PM?12/11/2001									
10											
21	Time	IA	IB	IC	IN	VAN	VBN	VCN			
22	(ms)	(A)	(A)	(A)	(A)	(V)	(V)	(V)			
23	0	0.03	0.03	-0.23	0	88.17	10.26	-94.96			
24	1.041667	0.03	0.15	-0.26	0	59.48	50.09	-105.04			
25	2.083333	0.03	0.23	-0.24	0	21.22	82.26	-98.26			
26	3.125	0.02	0.27	-0.19	0	-21.04	101.74	-78.78			
27	4.166667	0.02	0.28	-0.09	0	-58.43	106.78	-45.74			
28	5.208333	0.03	0.25	0.02	0	-87.3	96.7	-5.74			
29	6.25	0.03	0.19	0.13	0	-102.43	71.3	34.78			
30	7.291667	0.02	0.08	0.21	0	-101.74	35.65	69.57			
31	8.333333	0.03	-0.02	0.28	0	-85.57	-5.74	95.13			

369_23-20011211-140033-OSC

Ready

COMTRADE Data File Imported into Microsoft Excel

By default, PMCS Waveform Capture software saves waveforms in COMTRADE (IEE C37.111.1991) format as well as .CSV format. (You can disable saving in COMTRADE format on individual devices.) The COMTRADE standard defines a common format for storing digital records of transient events. For further details on COMTRADE file formats, refer to the specification above.

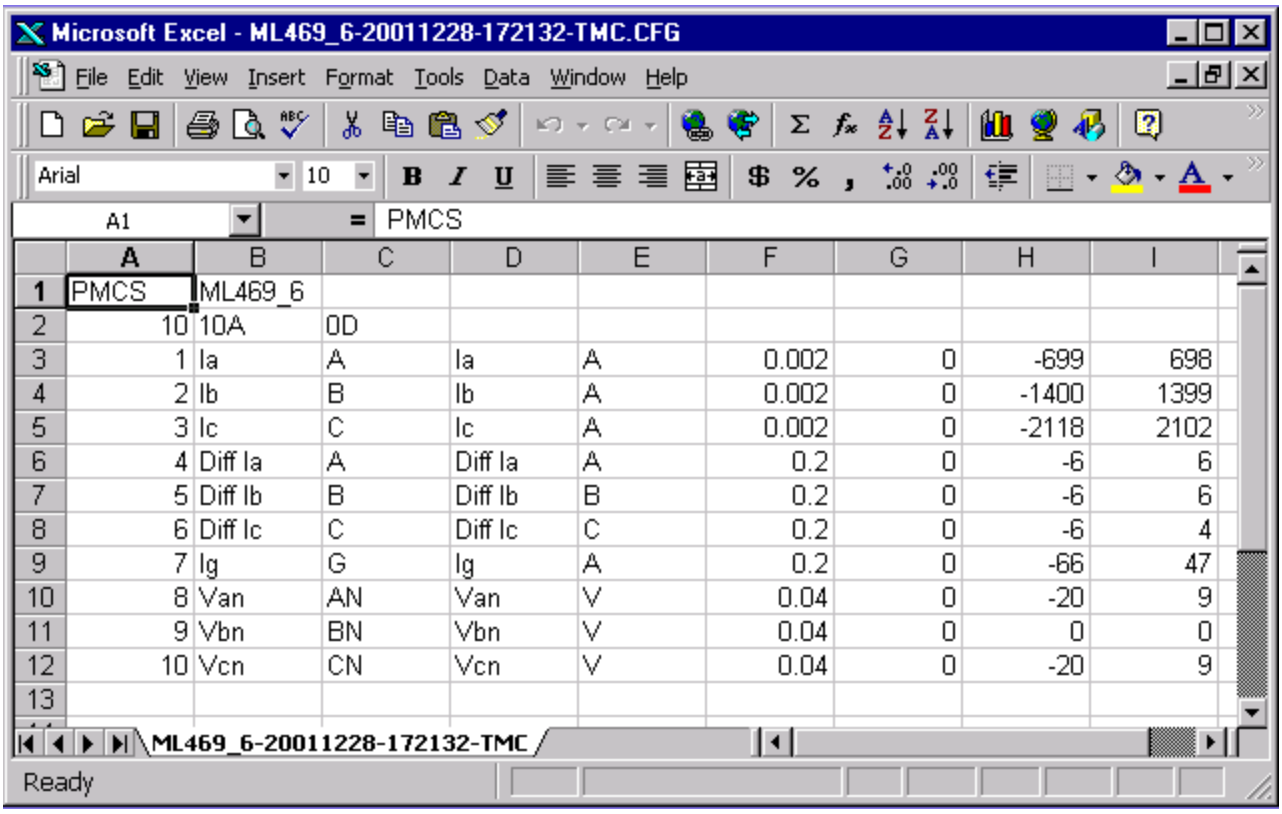
All COMTRADE-format waveform data files are stored in the following directory structure wherever the installation of their WFServer is located:

…/WFSERVER/WAVEFORMS/COMTRADEFILES

When a COMTRADE-format waveform is stored to disk, three separate files are created. Each file has the same name, but a different file extension. The COMTRADE file extensions are:

- .HDR - this file contains nothing and may be ignored, or edited to add user-specific information as needed. For F650 device, the HDR file contains Date, Time, Prefault, System_Frequency, Trigger, Samples_num, Samples_cycle, OSC_Number.
- .CFG - this file contains information on the configuration of the device
- .DAT - this file contains actual waveform capture data points and values

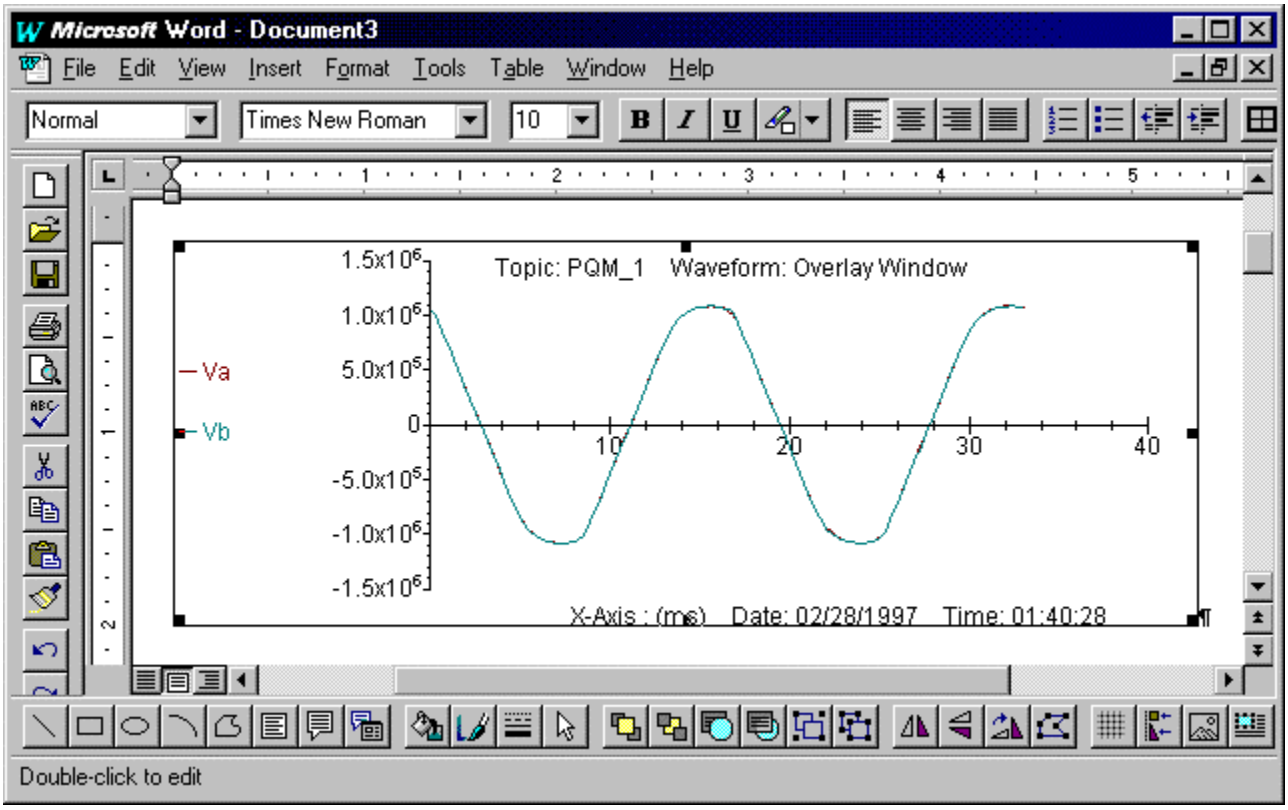
A variety of third-party tools are available for display, manipulation, and analysis of COMTRADE-format waveform files. The COMTRADE files may also be imported into most spreadsheet programs capable of importing comma-delimited data. For example, the picture below shows a waveform capture COMTRADE .CFG file imported into Microsoft Excel for data analysis and manipulation.



	A	B	C	D	E	F	G	H	I
1	PMCS	ML469_6							
2	10	10A	0D						
3	1	Ia	A	Ia	A	0.002	0	-699	698
4	2	Ib	B	Ib	A	0.002	0	-1400	1399
5	3	Ic	C	Ic	A	0.002	0	-2118	2102
6	4	Diff Ia	A	Diff Ia	A	0.2	0	-6	6
7	5	Diff Ib	B	Diff Ib	B	0.2	0	-6	6
8	6	Diff Ic	C	Diff Ic	C	0.2	0	-6	4
9	7	Ig	G	Ig	A	0.2	0	-66	47
10	8	Van	AN	Van	V	0.04	0	-20	9
11	9	Vbn	BN	Vbn	V	0.04	0	0	0
12	10	Vcn	CN	Vcn	V	0.04	0	-20	9
13									

Metafile (.wmf) Imported into Microsoft Word

The following picture shows a Metafile imported into Microsoft Word. The waveform was retrieved into the Waveform Capture Client from a Power Quality Meter, viewed as an overlay of the V_a and V_b data channels, then saved as a Metafile.



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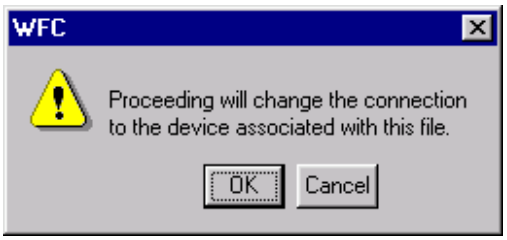
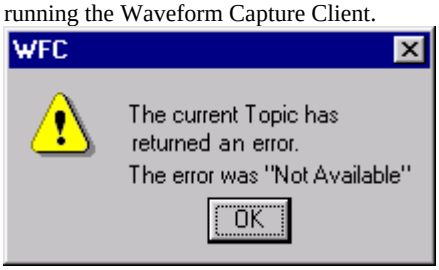
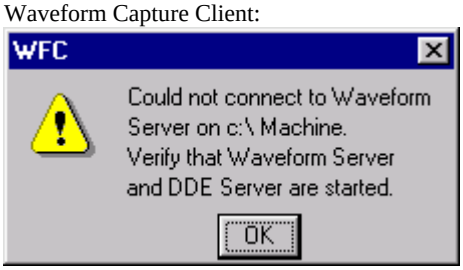
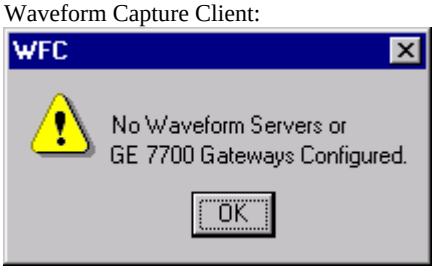
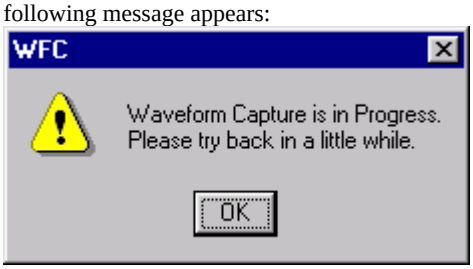
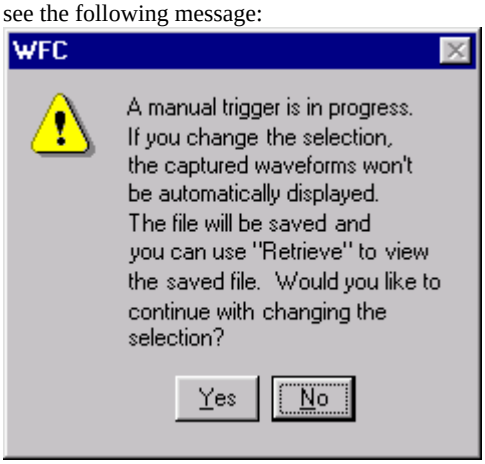
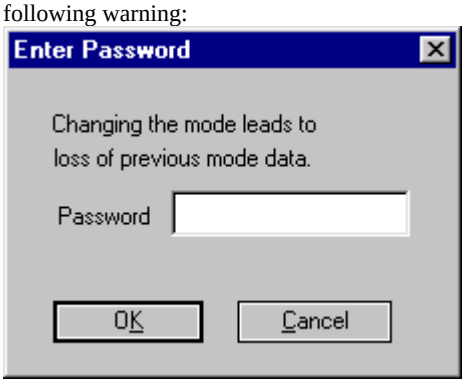
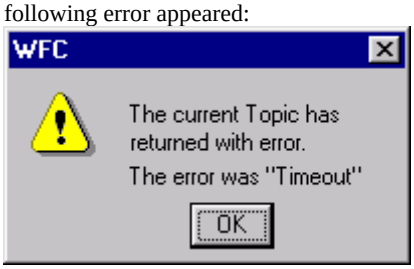
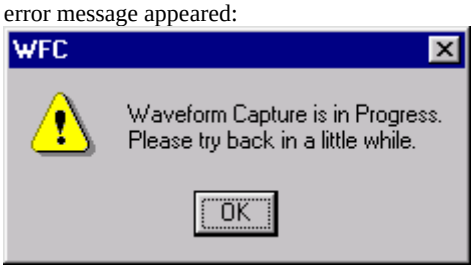
Trouble-Shooting

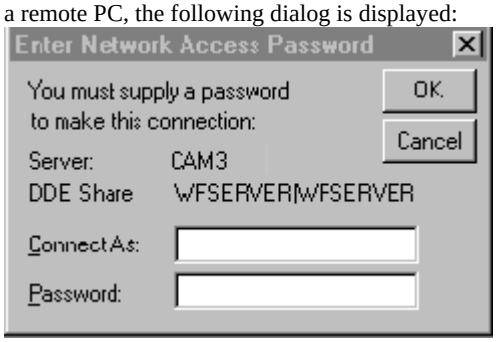
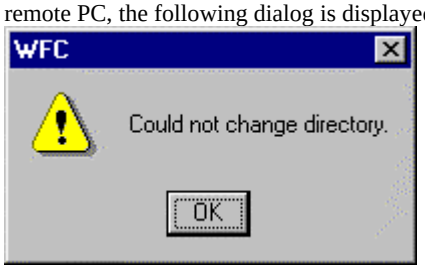
Error Conditions, Causes, and Solutions

Error Condition	Possible Cause	Solution
When I view my data in Microsoft Excel, the peak shown by the WFC software's harmonics display doesn't match the peak shown by the associated .csv file.	Software analysis differences.	This condition exists because the Waveform Capture Client software uses the first cycle data for its analysis. Other software may use a greater or lesser number of samples, resulting in a slightly different plot of the data.
I see the following error message when I try to open the WFClient. 	WFServer or GE 7700 Gateway is not running. and/or DDE Server is not running.	Start the PMCS DDE Server or GE 7700 Gateway, then the Waveform Capture Server, and finally the Waveform Capture Client software. The software must be launched in this order to function correctly. Check to make sure that the PMCS DDE Server, the WFServer, and/or the GE 7700 Gateway are in **Run** (as opposed to **Configure**) mode.
When I try to open a datafile or metafile, this warning message is displayed: 	An invalid file format (non-.csv) has been selected using the **Open Datafile** command from the **File** menu, or the file is corrupt.	Select a file with the appropriate format: .csv = datafile. If the extension is correct, but the error still appears, the selected file is corrupt and should be deleted from your hard drive.
When I try to open a datafile or metafile, this warning message is displayed:	A **Retrieve** or **Datafile Open** was issued, and the opened file has a device type different from the currently selected device type.	WFClient allows data from only one device to be presented at a given time. When you attempt to retrieve a waveform or open a datafile from a different device type, you will change the current device. To view data from multiple devices

Error Condition	Possible Cause	Solution
		simultaneously, open multiple Waveform Clients, each viewing a different device.
The following message appears while I'm running the Waveform Capture Client. 	The currently connected device has become dead or inactive and has stopped responding; or the DDE server has gone down	Check the status bar at the bottom of the main window for more information about the error that has occurred. Connection Failed to DDE Server means that the DDE Server has gone down. Shut down Waveform Capture and the PMCS DDE Server and restart all three applications. Device is DEAD means that the device in question has gone offline for some reason and the PMCS DDE Server cannot presently make contact with the device.
The following message appears when I start Waveform Capture Client: 	The WFServer is not running or is busy and could not send an Acknowledge reply.	Wait a few moments, then retry. If this fails, try starting or re-starting the WFServer and re-attempt the connection. If this fails, exit the WFClient and WFServer, then restart the WFServer and WFClient and re-try the connection.
The following message appears when I start Waveform Capture Client: 	No Servers are configured in the client.	Add configuration information for the Waveform Servers and GE77GTWYs on your system to the Waveform Capture Client.
I attempt to issue a **Trigger** command and the following message appears: 	Another WFClient is already performing a **Trigger** command on the selected device.	Wait a few moments while the other client's transaction is completed, then re-attempt the **Trigger** command.

Error Condition	Possible Cause	Solution
When I attempt to change the selected device, I see the following message: 	A disconnect is in progress.	Wait until the disconnect is completed, then change the device.
A **Trigger** command is in progress and the following dialog appears: 	The operation has been aborted due to some error in the device or data transmission.	Re-attempt the **Trigger** command after checking to make sure the device is online and functioning properly.
When I click the **Trigger** button, I see the following warning: 	Triggering a waveform capture in certain modes can alter the operation mode of the device itself.	Consult the device's documentation and be sure that you understand what each mode does and how it affects device operation before you use Waveform Capture to trigger waveform retrieval with any of these modes.
I attempted to **Trigger** a waveform retrieval and the following error appeared: 	An error accessing the topic occurred at the PMCS DDE Server.	Check the WFClient Status Bar for more information. You'll probably see a message similar to this: **Retrieve WFRecord for (topic) FAILED.** This means the software was unable to collect the data it needed. Check the configuration of the topic at the DDE Server and the device itself to make sure it is functioning properly, and then re-attempt the **Trigger**.
EPM 3710 waveform capture data shows a large	Data from this device has	It is not possible to determine the offset in the

Error Condition	Possible Cause	Solution
dc component.	an offset.	Waveform Capture software. Ignore the dc component.
I triggered a waveform retrieval and the following error appeared: 	The operation has timed out due to a communications failure.	Re-attempt the trigger operation. If it does not succeed, check to make sure the WFServer and PMCS DDE Server are operating correctly and that the device is online and functioning properly.
I attempted a **trigger** command and the following error message appeared: 	A waveform capture is in progress or the WFServer is busy collecting setup data from the device. Check the Status bar for more information.	Wait until the **Waveform Server Ready** message appears in the Status bar.
I expanded the size of a graph and found that the fonts appeared distorted.	Graphics may be resized vertically, horizontally or proportionally. Resizing the graphic horizontally or vertically distorts the fonts.	Resize the graphic proportionally to maintain font display.
Vertical lines appear with very wide widths, making the graph display poor or illegible.	The acceptable line width needs to be adjusted.	Invoke the plot parameters dialog by double-clicking on the graph. Adjust the acceptable line width range. This value should be in the range 0 to $3.6e^{-2}$.
It is very difficult to invoke plot selection parameters on a graphics window.	Plot selection is sensitive to location of pointer.	Click at the top of a curve or very close to but not on the plot's axis.
The graph intercepts are missing or the display of the graph looks terrible.	Display may have been adjusted.	Re-open the file to restore the graph to its default display setting.
When I print the graph, some lines don't print or are very faint.	The line color may be light.	Some light colors, such as yellow, print poorly. Avoid using light colors for graphing.
The waveform plot appears smoother than it should be, and peak values are missing or reduced in magnitude.	By default, WFClient applies a Spline curve fit to the data.	Double-clicking the graph and de-select the Spline fit checkbox in the dialog box.

Error Condition	Possible Cause	Solution
When attempting to connect from my Waveform Capture Client to a Waveform Capture Server on a remote PC, the following dialog is displayed: 	The user name and/or password are different between the WFServer and Waveform Capture Client machines.	Log in as the same user on both machines.
When attempting to connect from my Waveform Capture Client to a Waveform Capture Server on a remote PC, the following dialog is displayed: 	The \GE_*PMCS* directory on the Waveform Server machine is not properly shared.	The \GE_*PMCS* directories on the Waveform Server machine must be shared with full access permissions.
WF Server is showing "Unable to store xxx in the backup directory" error messages.	The backup directory on a networked machine may not be properly shared or have proper permissions set.	Check the permissions and sharing properties and enable full permissions and proper sharing.
The following error appears during waveform uploading: 	The timeout value in the registry does not meet the minimum requirements for device and network conditions.	Edit the HKEY_LOCAL_MACHINE\SOFTWARE\GE\PMCS\60 WFServer\Device Settings key. The timeout value is represented by the seventh parameter under DeviceSettings. Its value is in milliseconds.
The data in upload and trigger waveform files representing the same event (same date and time on both files) does not match, or the data retrieved by multiple uploads of the same event does not match.	The Latency value setting does not match with device and network requirements.	Adjust the device's Latency setting in the WF Server application under Server \ Configure \ Device Settings. Select a device type and then select the individual device from the list of configured devices.
Cannot close the Waveform Server.	Application is configured as a Windows NT Service.	Log on as a System Administrator, and shut down the application from the Services control panel.

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