



WaveGen-Studio User's Guide

Welcome!

WaveGen-Studio is a feature-rich, powerful system designed for managing physical hydrodynamic studies. It combines the four elements of data acquisition, wave synthesis, wave generation and wave data analysis in a seamless, intuitive graphical interface designed to allow users to easily manage even the most complex experiments. Each of the components is included and configured individually through the license file.

The system uses a network of connected servers to provide the necessary data acquisition and control capabilities. Data acquisition servers allow data to be acquired from sensors used in a study and control servers are used to control the electric or hydraulic actuators to generate waves.

Wave synthesis and wave data analysis with sophisticated plotting capabilities are provided by the National Research Council Canada's GEDAP system. GEDAP is a well-proven, complete software solution for physical modelling in hydrodynamic laboratories. Commonly used GEDAP programs have been integrated into WaveGen-Studio for interactive use. GEDAP programs, GPLOT and batch file processing are also available through the Windows Command Prompt.

Wave generation is the process of moving one or more actuators to generate waves. Wave generation with and without active wave absorption are supported. For 2D flume systems, a single controller provides closed-loop control of the position or velocity of the one or two actuators that power a wave board. For 3D basin systems, a bank of controllers provides closed-loop control of the position or velocity of the single actuator that drives each wave board. Both electric and hydraulic actuators are supported.

WaveGen-Studio and GEDAP are designed to run by a single User on any PC running Microsoft Windows 7 or Windows 8 Operating System.

The Guide Layout Explained

The screen captures used in this manual are taken from a fully featured WaveGen-Studio configured for data acquisition, analysis and 2D and 3D wave generation. The screens on your WaveGen-Studio may differ from these.

Revision History

The WaveGen-Studio User's Guide is updated periodically to reflect new system capabilities, provide more information, and to correct errors.

Date	Revision	Description
31/03/2015	1	Initial version.
31/10/2015	1.1	Updates and corrections.
29/11/2015	1.2	Updates and corrections.

Table i: Revision History

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Features of Your WaveGen-Studio

Your WaveGen-Studio and GEDAP can be configured to provide a wide range of user requirements. Simple analysis-only workstations to fully configured operator interface workstations that support data acquisition, wave synthesis, wave generation and wave data analysis for 3D facilities are possible by selecting the desired set of functionality packages from the matrix below.

Data Acquisition

WaveGen-Studio and GEDAP functionality package options for data acquisition include:

ADQ-Basic - basic analog input from a single Data Acquisition Server. This package includes the GEDAP Basic Data Analysis and GPLOT packages.

ADQ-Advanced - advanced data acquisition from a single Data Acquisition Server. Analog I/O, digital I/O and quadrature encoder input are all supported. This package includes the GEDAP Basic Data Analysis, Advanced Data Analysis and GPLOT packages.

ADQ-Multiple - advanced data acquisition from two Data Acquisition Servers. Synchronized input and output of analog and digital data are supported. This package includes the GEDAP Basic Data Analysis, Advanced Data Analysis and GPLOT packages.

Package	# DAQ Servers	Input				Output		Analysis		
		Voltage	Digital	Encoder	Strain Gauge	Voltage	Digital	Basic	Advanced	Plot
ADQ-Basic	1	✓						✓		✓
ADQ-Advanced	1	✓	✓	✓	✓	✓	✓	✓	✓	✓
ADQ-Multiple	2	✓	✓	✓	✓	✓	✓	✓	✓	✓

GEDAP Software

Table ii: Data Acquisition Package Functionality Matrix

Wave Generation

WaveGen-Studio and GEDAP functionality package options for wave generation functionality are shown in the table below.

AWAVE-2D - wave synthesis and basic analysis for 2D wave generation (flumes). This package includes the GEDAP Basic Data Analysis, Advanced Data Analysis, 2D Wave Synthesis and GPLOT packages.

AWAVE-3D - wave synthesis and basic analysis for 3D wave generation (basins). This package includes the GEDAP Basic Data Analysis, Advanced Data Analysis, 2D Wave Synthesis, 3D Wave Synthesis and GPLOT packages.

AN-2D - wave analysis software for 2D wave analysis. This package includes the GEDAP Basic Data Analysis, Advanced Data Analysis, 2D Wave Analysis and GPLOT packages.

AN-3D - wave analysis software for 2D and 3D wave analysis. This package includes the GEDAP Basic Data Analysis, Advanced Data Analysis, 2D Wave Analysis and 3D Wave Analysis and GPLOT packages.

AGEN-MGMT-2D - wave generation operator interface for a flume wave generator controller.

AGEN-MGMT-3D - wave generation operator interface for a segmented wave generator controller.

AWA-2D - active wave absorption integrated with a flume wave generator controller.

AWA-2D-3-Probe - active wave absorption in a wave flume using the 3-probe method with an external wave generator controller.

AWA-3D - active wave absorption integrated with a segmented wave generator controller.

Package	Notes	2D Waves				3D Waves				Analysis		
		Synthesis	Generation	Analysis	Absorption	Synthesis	Generation	Analysis	Absorption	Basic	Advanced	Plot
AWAVE-2D		✓								✓	✓	✓
AWAVE-3D		✓				✓				✓	✓	✓
AN-2D				✓						✓	✓	✓
AN-3D				✓				✓		✓	✓	✓
AGEN-MGMT-2D			✓									
AGEN-MGMT-3D							✓					
AWA-2D	1				✓							
AWA-2D-3-Probe	2				✓							
AWA-3D	1				✓				✓			

GEDAP Software

Table iii: Wave Generation Package Functionality Matrix

Notes:

1. Capability is available with Akamina Technologies Control Servers
2. Capability is available with any external controller.

Introduction

Installation

This section explains how to install and activate WaveGen-Studio on a Windows™ PC. It assumes you have experience in installing and configuring software in a Windows environment. If this is not the case, step by step guidance to the installation and licensing of your WaveGen-Studio is provided in the Reference section on page 57.

The installation described and shown here is for a fully featured WaveGen-Studio. Certain features will not be available and certain sections of this manual will not be applicable to a User with a more restricted License.

Minimum Hardware Configuration

The minimum hardware requirements for your WaveGen-Studio PC is an Intel i5 or i7 processor (or AMD equivalent) with a minimum of 16 GB RAM and 1TB HDD running Windows™ 7 64bit or Windows™ 8 64 bit operating system.

Note: Because of the high data bandwidth requirements, all of the data acquisition and control servers should be located on the same Gigabit LAN.

Note: Letting the PC running WaveGen-Studio go into sleep mode will disturb any ongoing data collection. The PC can be configured to turn off the display, but the settings for sleep mode of the computer, and HDD should be set to “never”.

Quick Start

If you are an experienced Windows™ user follow the steps below to install and licence your WGS software.

Note: WGS requires Microsoft .Net Framework 4. The installer will automatically install this if it has not already installed.

Connect your Data Acquisition or Control server to a LAN configured to an address on the same subnet. The WaveGen-Studio factory default server IP address is 192.168.1.30. See ‘How do I change the IP address of my WGS on page 53 to change this.

To install WaveGen-Studio double click the .msi file and follow the installation steps accepting the recommended choices.

On completion of the install, start WaveGen-Studio. You will be asked for a license file. Contact Akamina with your Installation ID either by phone or email. Obtain a license file and copy it to a suitable folder on your PC. In the License window, click the Update License button, browse to the folder where you stored the license file, select it and click Open. The license window will be refreshed to show the features of your license. Close the window and re-start WaveGen-Studio.

Note: This license file is unique to this installation, is not transferrable and must remain available when using the WGS. It also enables the corresponding GEDAP functionality.

Before you finish the quick start steps, you are recommended to test your GEDAP installation. To do this, see Install and Test my GEDAP in the Reference section on page 61.

User Interface

Window Layout Described

When WaveGen-Studio starts a window similar to the one shown in Figure 1 will open. The window is made up of the following five areas:

1. The Banner includes the Akamina Logo, the program name (WaveGen-Studio) and a Window Management Area in the top-right corner.
2. The Ribbon Control area includes the tabs, buttons and sliders that provide access to the underlying forms and features. The tabs, button and sliders are automatically configured based on the system capabilities that have been licensed.
3. The Main Window is the interactive user interface area. The contents of the window vary depending on the interface that is active.
4. Important status messages as well as any error messages are displayed in the **Message Window**. A vertical slider bar appears when the amount of information to be displayed exceeds the number of lines available. A complete history of the messages from this session is available for review. Any messages displayed include a time stamp that indicates when the message was generated. The control at the top-centre of the window can be used to adjust the height of the window or to minimize it.
5. The **Status Bar** provides a visible indication of the status of various components of the data acquisition system:
 - **DAQ Database:** indicates whether the data acquisition (DAQ) database has been opened (green) or not (red). A data acquisition database must exist before other data acquisition features of the interface can be used.
 - **Control Database:** indicates whether the control (CTRL) database has been opened (green) or not (red) Note: If the installation is not licensed for wave generation, this indicator will not be visible. A control database must exist before wave generation and control features of the interface can be used.
 - **Servers connected:** indicates whether all servers are connected (green) or not (red). If one or more of the servers that have been added are not connected, the Servers connected indicator will be red.
 - **Servers active:** indicates whether all servers are sampling (green) or not (red). This indicates whether all servers are sampling data; it is not an indication of whether the WaveGen-Studio is actively acquiring data from the server. A server is considered Active when it is sampling data and storing that data in its internal buffer. As with the connected indicator, the active indicator is green if and only if all provisioned servers are active.

Screen Captures in this Manual

Screen captures shown in this manual are taken from a fully licensed WaveGen-Studio. The screens on your WGS may differ from these according to set of features licensed for your application.

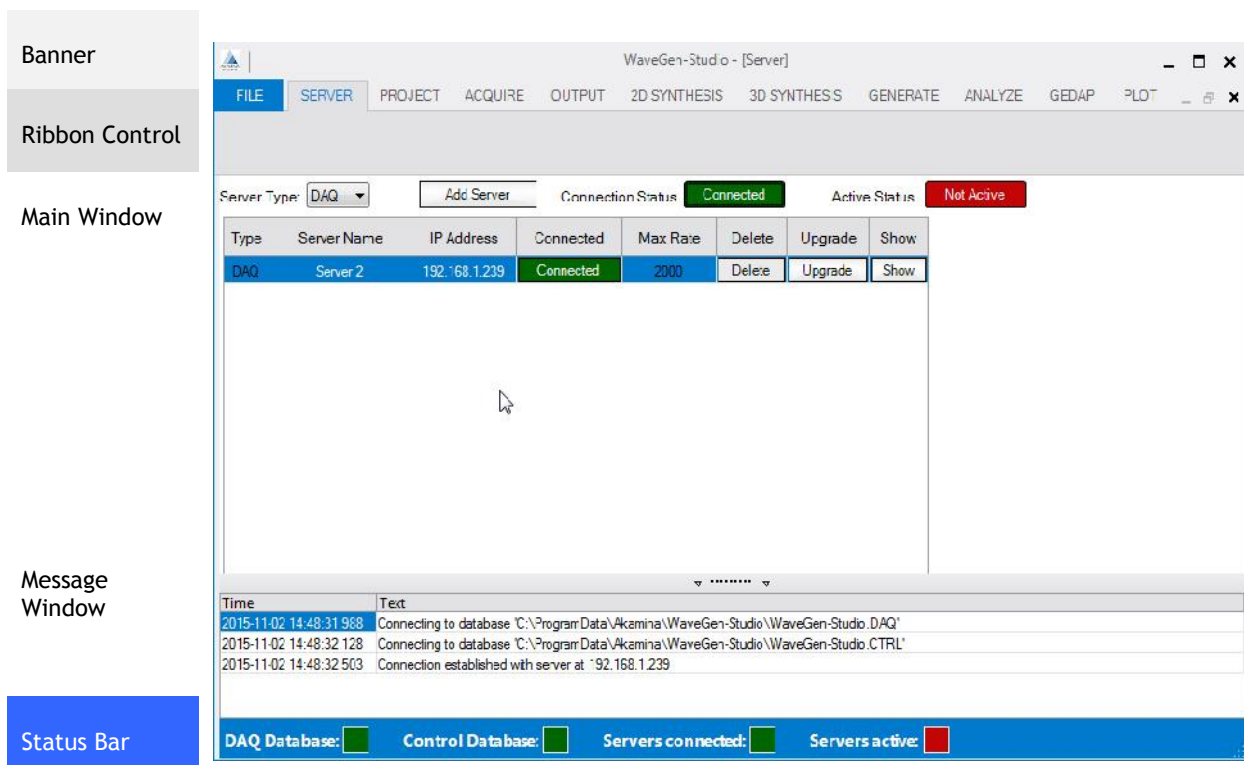


Figure 1: WaveGen-Studio User Interface Window

Activities and Options Explained

The selection of tabs that any user will see is dependent on the licensed capabilities of the WaveGen-Studio installation. Figure 2 below shows all the available tabs. The functionality of each of the tabs in the Main Menu bar is further divided up into Activities based on the functionality required within a phase of the life of a project. The name of the Activities appears on the third line of the Main Window.

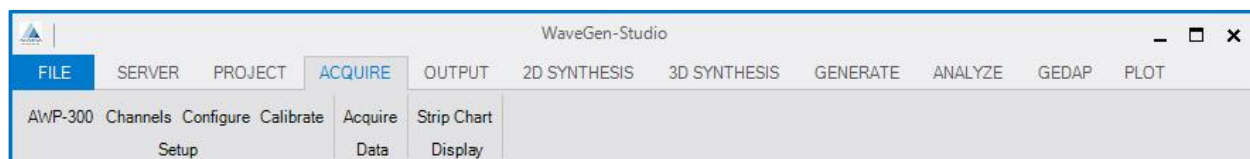


Figure 2: Activities and Options Explained

For example, in Figure 2 there are three Activities under the ACQUIRE tab related to acquisition of data; they are: Setup, Data and Display. These Activities do not actually control the functions; they provide a logical way to group the Options that can be selected to carry out the required function.

The Options grouped in each Activity are listed above the activity line. For example the Options of the Setup Activity are: AWP-300, Channels, Configure and Calibrate. Throughout this guide how to select an option (for example Configure) will be written as:

ACQUIRE → Setup → Configure.

To Select an Option

An Option is selected by clicking the desired Main Menu tab and then moving the mouse over the desired Option which turns the background white. Click to select the Option; the background turns blue and the option appears in the WGS main window. At the same time the banner section of the WaveGen-Studio window changes to include the selected Option. For example, having selected the Option ACQUIRE→ Setup →Channels, WaveGen-Studio-[Channels] will be shown in the top line of the window. The content of the Main Window is not updated until a valid Option is selected.

If the Option is accompanied by a down arrow (see Figure 3), multiple choices are available under this Option main heading. To continue, select the specific Option from the pull down list under the arrow. Returning to this Option after selection will show the selection marked with a tick.

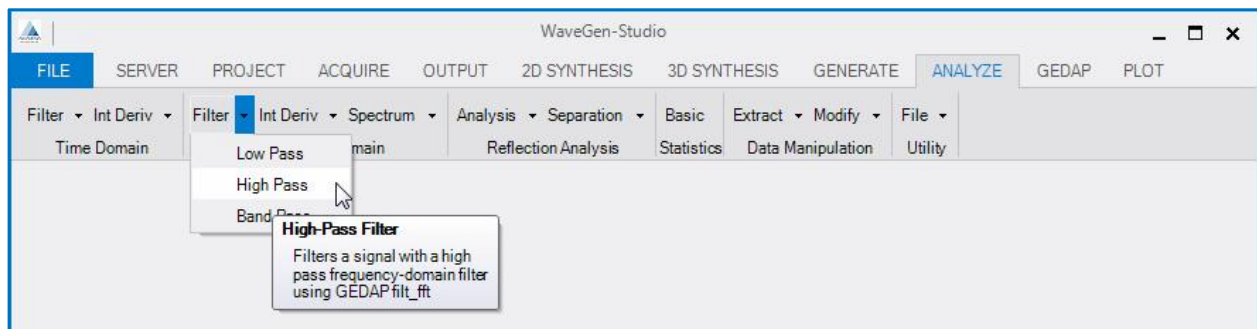


Figure 3 Choosing an Option from the Pull Down list

The FILE tab is an exception to the above. Its capabilities are accessed via a pull-down menu. The FILE tab itself is always highlighted in blue.

Getting help

Help is provided at several levels in your WaveGen-Studio and alternatively from the Windows TM command line Help. The command line approach can also be used to run individual routines or GEDAP programs using WaveGen-Studio generated data. See Command Line Help on page 13.

Context Help

The message window provides a set of error messages concerned with system configuration errors. Resolving these usually requires user action; for example to configure a sensor that has been moved from its (last configured) CAN Bus location or to change a Server IP address to allow connection.

Pop-up Help

An attempt by the user to carry out an action that is not possible with the current state of the server produces a pop up window describing the problem and suggesting the appropriate corrective action. Figure 4 shows the result of trying to setup an AWP-300 sensor without a valid server connection.



Figure 4: Pop Up Help

Tool Tip Help

Many but not all of the Options and parameter selection fields are provided with a tool tip help. Hovering the mouse over a field will produce a popup which explains the action that the selected option or parameter will carry out. For an Option this includes the name of the Option, a description of the action to be carried out and the name of the GEDAP program that will implement this Option. Hovering over a parameter field (shown in Figure 5) shows the name of the field, the action required of the user and any limits for this parameter.

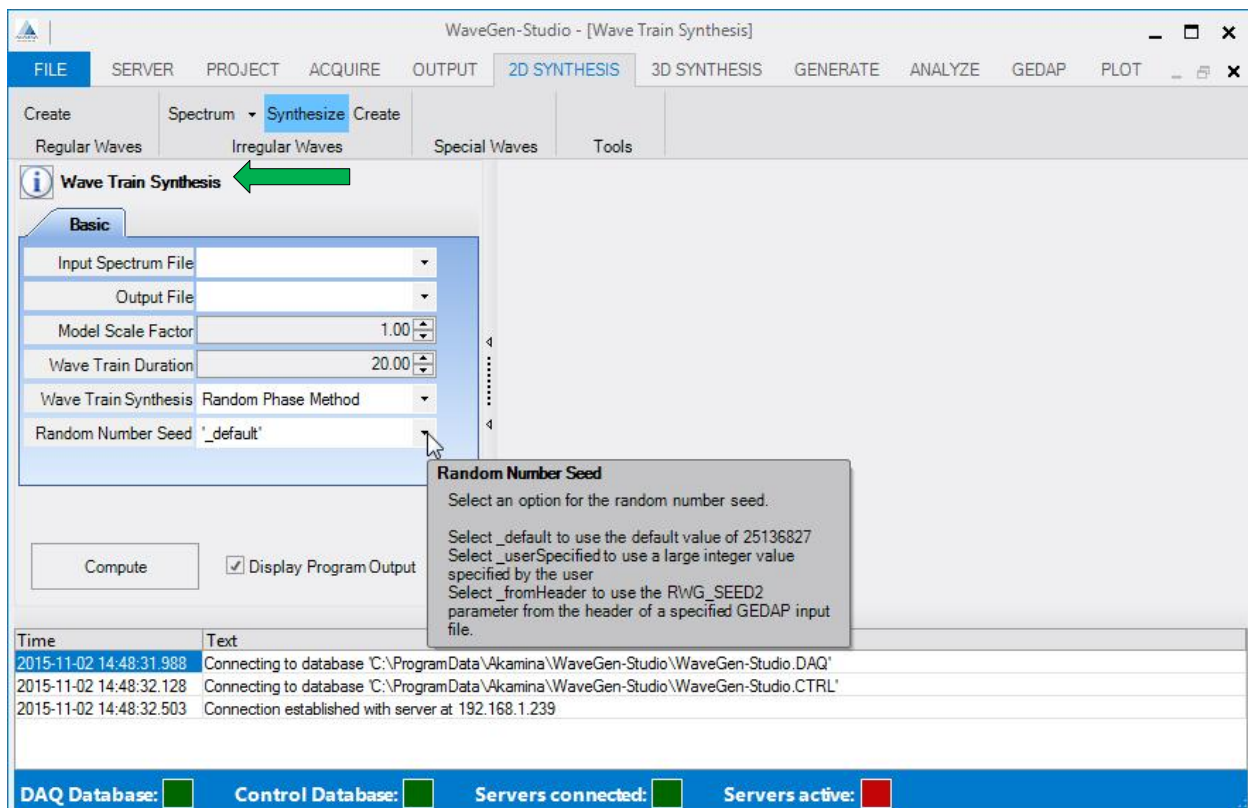



Figure 5: Tool Tip Help

The Help Button

Help buttons  are available on each of the 2D SYNTHESIS, 3D SYNTHESIS and ANALYZE main tabs. The button is context sensitive and provides a direct link to the help for the chosen GEDAP function. Figure 5 shows the Help button for the 2D SYNTHESIS → Irregular Waves → Synthesize choice and next to it, the GEDAP program name. Clicking this button launches a browser window containing the Akamina GEDAP help (shown in Figure 6).

The help window contains two panes: the left hand pane shows an expandable structure containing all the GEDAP programs grouped into two section: a Main section containing all the Analysis and Synthesis programs and a Lib(rary) section containing all of the GEDAP subroutines. Sections may be expanded (+) and shrunk (-) and individual programs selected from the alphabetic list for display in the right hand pane.

The right hand pane shows the contents of the specific help file selected either through the left hand pane, or from the source options help button. The content contains a description of the GEDAP program, definitions of the data files, input and output parameters, limits, a record of any algorithms used and the source references for the program.

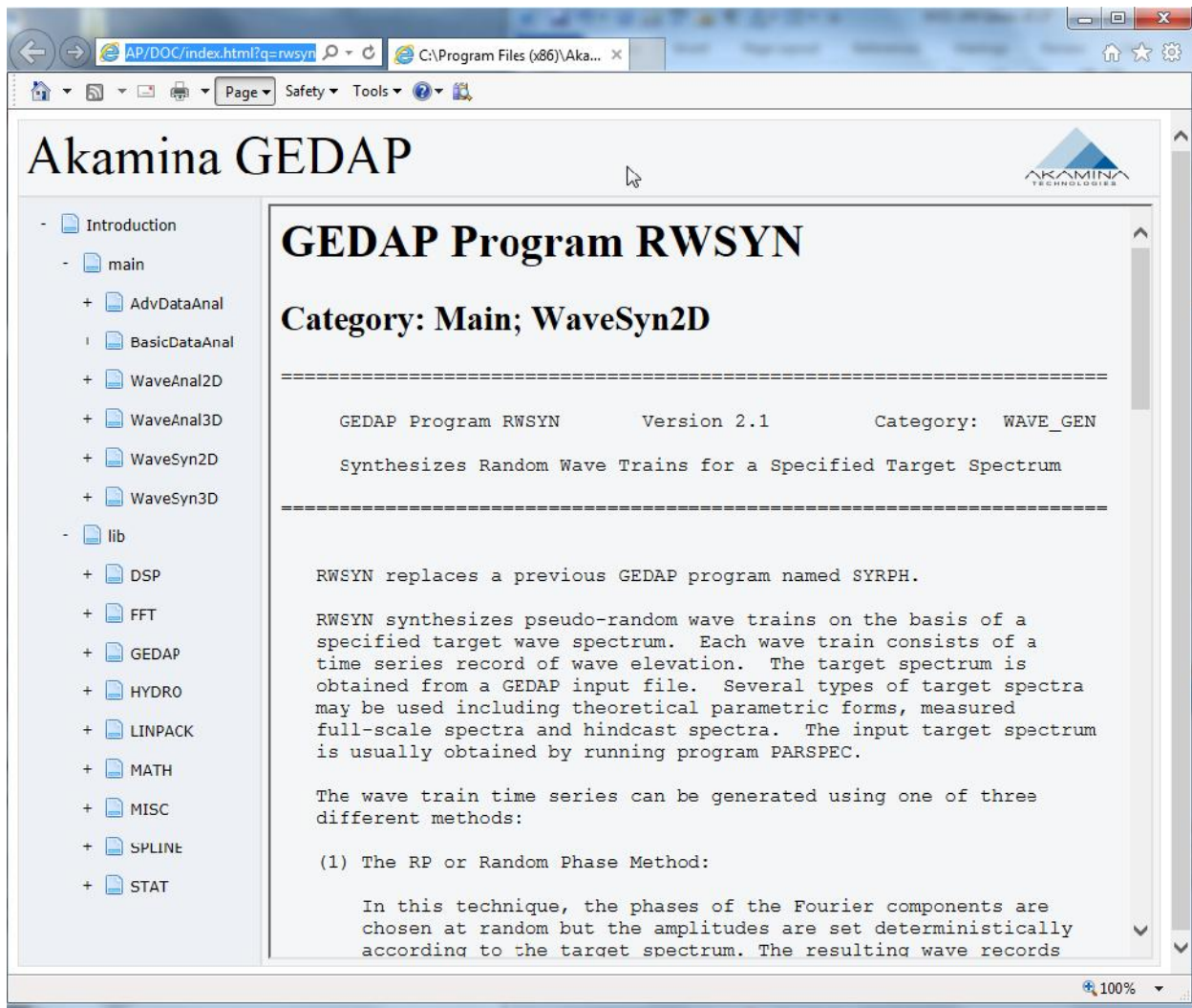


Figure 6: Help Button Results

Command Line Help

You can also access help through the Windows™ command line. To do this click the Windows™ start button and type **CMD** and return in the Search programs and files field. In the pop-up window type '**ghelp**' to launch a scrollable GEDAP help file. Similar in layout to the Help button results, this help file describes the GEDAP package, provides an organizational layout and a list of the GPLOT and GEDAP programs and routines as well as links to the individual programs. Similar to the help button, the left hand pane contains the same expandable access structure to GEDAP Main and Lib(rary) programs.

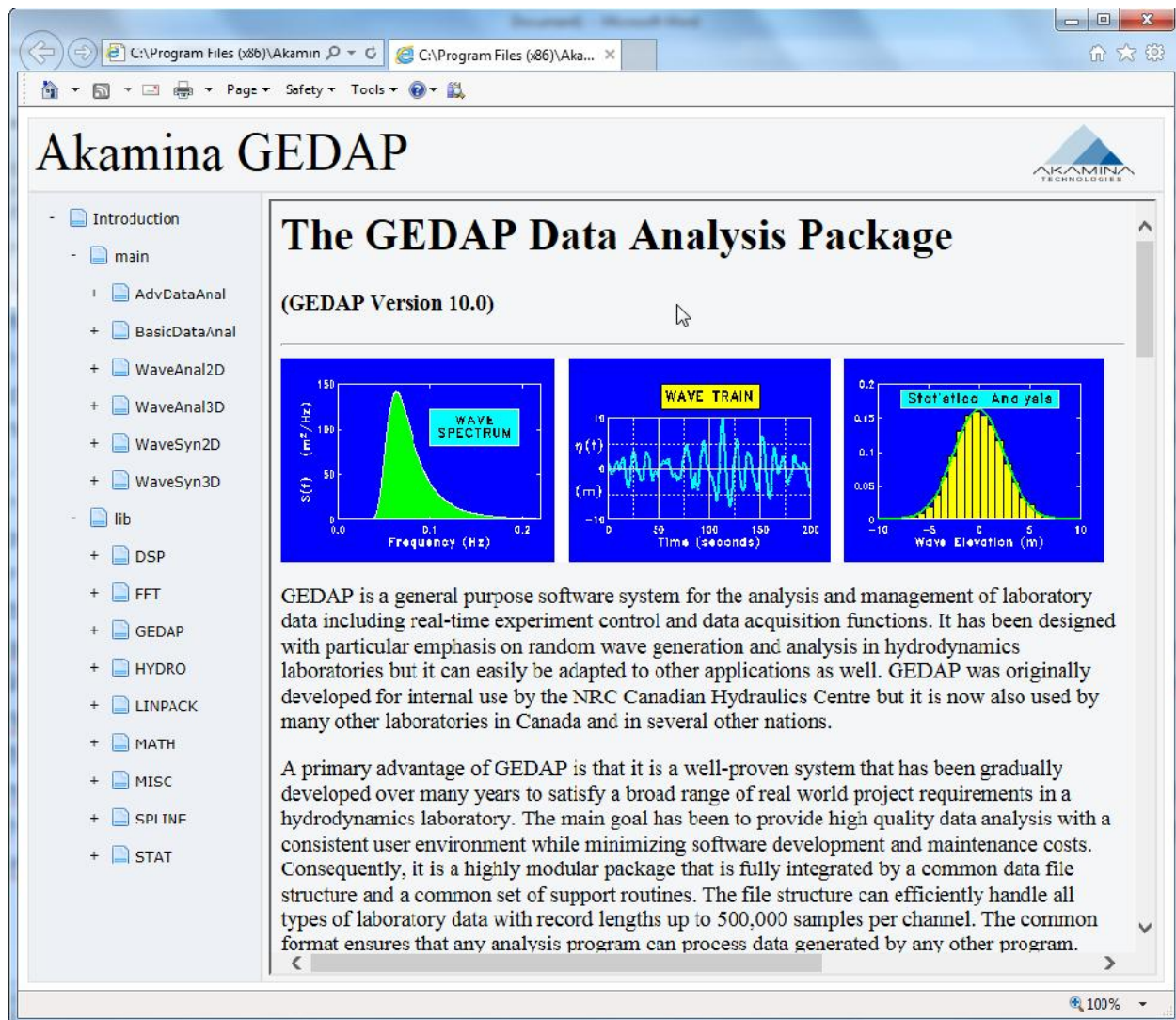
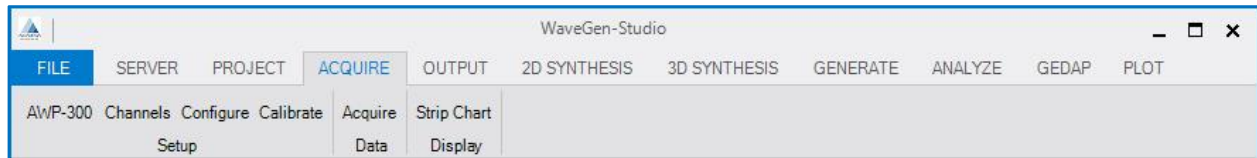


Figure 7: Command Line Help Results

An Overview of the Tabs

The tabs described below are those available to a user on a fully featured version of the WaveGen-Studio. If a feature is not licensed, the corresponding tab will not appear and there will be no access to the lower level Activities and Options.



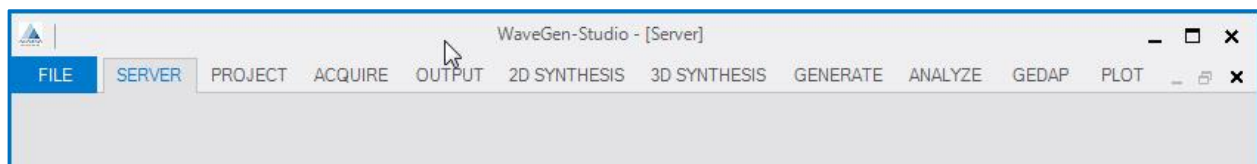
File Tab

The File tab is where the contents of the Data Acquisition (DAQ) and Control (CTRL) databases are managed and controlled. Data files can be exported, the WGS version and the current licensed capabilities can be viewed and the application exited.

Note: Each time a new database is created, the contents of the existing database are lost.

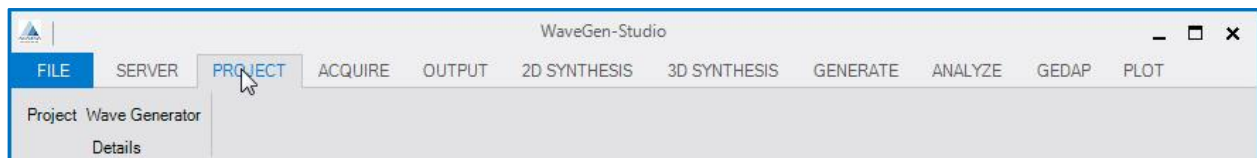
Server Tab

The SERVER tab has no Activities and is where servers are identified and managed by WGS. This tab contains two pages, one for Data Acquisition servers and one for Control servers. The page display is selectable through the Server Type pull down.



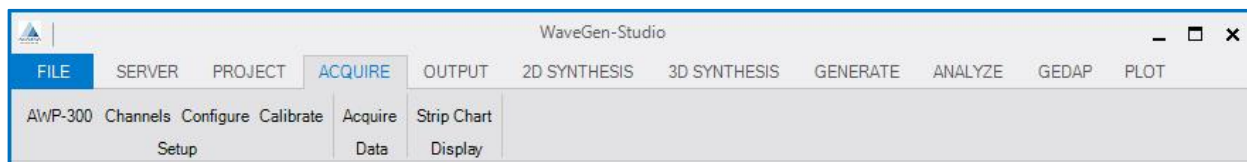
Project Tab

The PROJECT tab has only one Activity (Details) and two Options available: Details → Project is used to capture and display details about the current Project. These details will overwrite the details of any existing project in the database. Details → Wave Generator is used to specify the configuration of a 3D wave generation system.



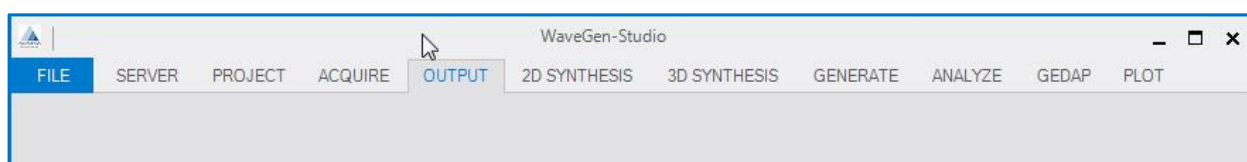
Acquire Tab

The ACQUIRE tab is the heart of the WGS data acquisition and includes everything concerning setting up the sensors for data acquisition; including: the selection and configuration of the sensors; sensor calibration; data acquisition and display of data. Multiple acquisition runs can be made within a single project and the resultant data analyzed and/or exported.



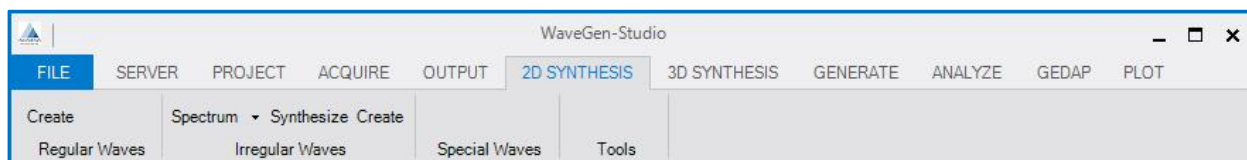
Output Tab

The Output tab allows the user to set up and control the playback of previously created GEDAP files (.001 files) through one of the available independent analog outputs. These outputs can be used as a generator control signal in a 2D flume system or as a steering mechanism for current or wind generator motors in a 3D basin system. Digital outputs can also be set high or low using this tab.



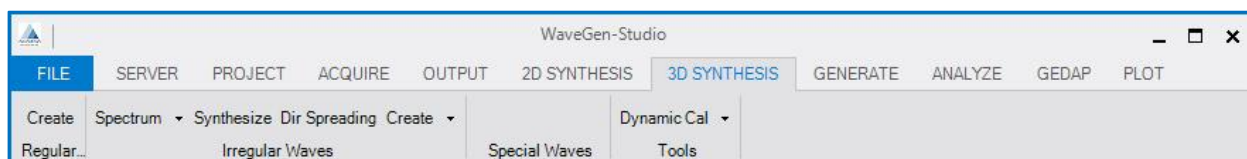
2D Synthesis Tab

The 2D Synthesis tab coordinates the two dimensional wave synthesis capabilities for a wave flume. Options in this activity include: dynamic calibration of wave generators, synthesis of wave spectra using parametric models, synthesis of random wave trains for a target spectrum and wave machine drive signal creation. Control over spurious long-wave components and the generation of episodic waves are also supported.



3D Synthesis Tab

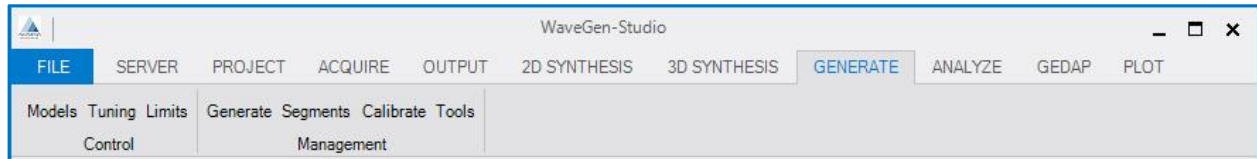
Use this tab to synthesize waves for a 3D wave basin. Options in this activity include: computation of various cosine-squared spreading functions, generation of long-crested wave trains and dynamic calibration of segmented wave generators.



Generate Tab

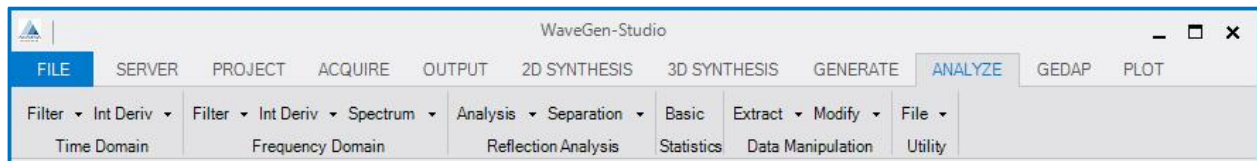
The Generate tab is only present on a suitably licensed WaveGen-Studio and includes the activities Control and Management. Control is further broken down into the options: Models, Tuning and Limits; Management is further broken down into the options: Generate, Segments, Calibrate and Tools. Of the options under the Control tab - Selecting the Model and Applying Tuning are typically installation dependent and should only be modified by

experienced personnel. These options are explained under Commissioning the Control System in the Advanced Topics section on page 47.



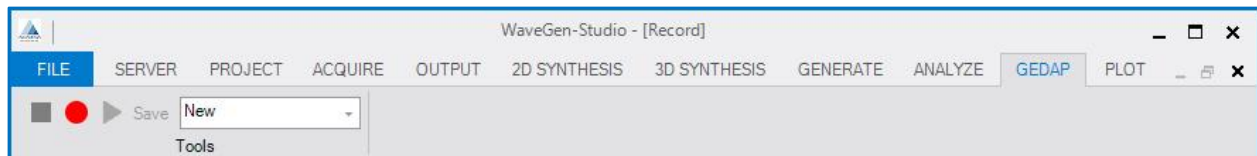
Analyze Tab

The Options included under the ANALYZE tab enable the user to analyze the acquired data using Time Domain, Frequency Domain, Reflection Analysis Statistics, or Data Manipulation techniques and a Utility to import and export csv formatted data files. These analysis tools draw on the library of GDAP files accessed through and explained in the GEDAP Features section (see page 62).



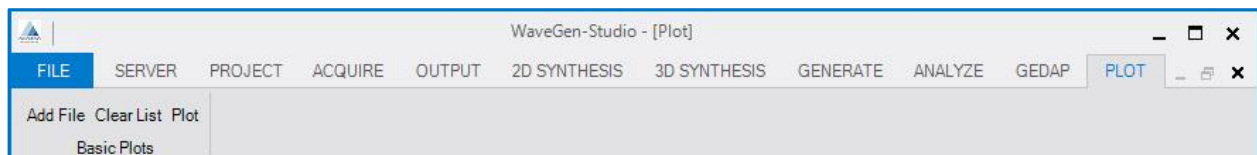
GEDAP Tab

Under the GEDAP tab, the user has the ability to record and playback commands (macros) involving GEDAP routines and programs. This greatly simplifies the process of carrying out the same operation multiple times on the same or similar data.



Plot Tab

Limited plotting capability is available under the PLOT tab. This is intended to be used for a visual display of one or more data files. Files for viewing can be added one at a time, multiple files can be overlaid and plotted with interactive zooming if required and the plot area can be cleared. The GPLOT package is available if more advanced plotting capabilities are desired.



Starting an Acquisition Project

This section will describe sequentially all the steps in the creation of a new Data Acquisition project. The sequence also provides a quick access guide to individual actions often repeated in a project (e.g. another acquisition run, or an analysis of a previous run) with pointers to the relevant pages describing the action and the steps required to complete it.

1. Start Up of WaveGen-Studio - see this page
2. Create a DAQ database - see page 19
3. Identify the Project - see page 20
4. Add and configure the servers-see page 20
5. Server, Devices, Channels, CAN Bus and Sensors explained - see page 23
6. Using AWP-300 sensors - see page 53
7. Discovering sensors-see page 54
8. Assigning sensors to a channel - see page 55
9. Fine Tune selected sensors - see page 57.
10. Manage the channels (make a subset of active channels) - see page 24
11. Configure (select a subset from active channels) - see page 27
12. Select the channels for Calibration - see page 28
13. Collect Sensor Calibration Data - see page 29
14. Perform the data acquisition - see page 31
15. Display the results - see page 33
16. Analyze the Data - see page 35
17. Creating and using Macro Commands - see page 36
18. Plotting the results - see page 36

Start Up of WaveGen-Studio

WaveGen-Studio requires an acquisition database in order to proceed at start-up. It does not require a CTRL database. The program will attempt to open an acquisition database when it is activated. There are 3 possible outcomes:

- a) **If the DAQ database does not exist**, WaveGen-Studio will start with the FILE tab visible and a message in the Message Window shows that a database was not found followed by an instruction to create a database using the FILE tab, (i.e. FILE → New DAQ Database).The indicators in the status bar at the bottom of the window are all red.
- b) **If the DAQ database does exist** when the program starts but a connection with a server has never been established, WaveGen-Studio will start with the SERVER tab visible. The indicators in the status bar are DAQ - green, CTRL - red, Server Connected - red and Server active - red.
- c) In the most common start-up situation, the **database will exist and at least one server will have been connected** at some point in time. With this information, WaveGen-Studio automatically attempts to connect to the database and any servers defined in the database. If the connections can be established, the window shown in Figure 8 is displayed. Note: the message in the Message Window section indicating that a connection to the server was established. The indicators in the status bar at the bottom of the window indicate: DAQ database is connected (green), the server is connected (green) and the server is not collecting data (red).

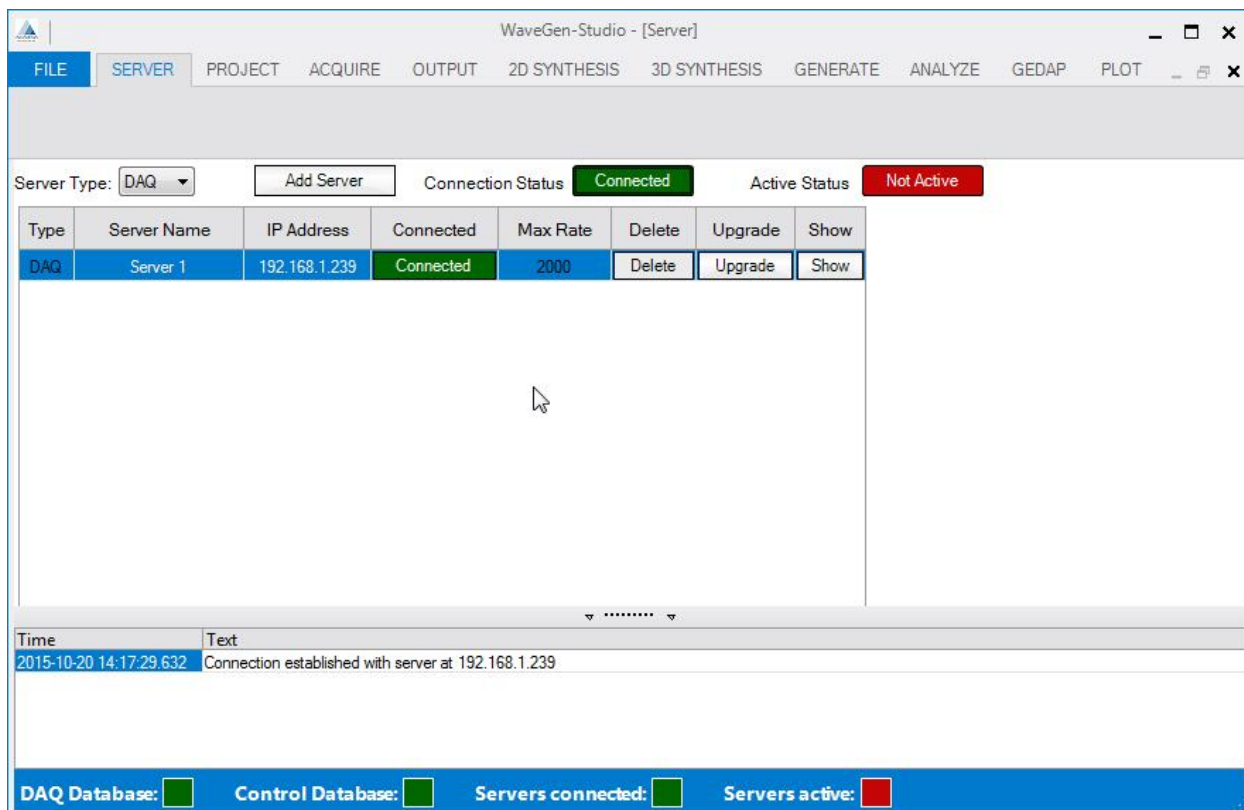


Figure 8: WaveGen-Studio Start-up-With Database and Server

Create a New DAQ Database

A database is used by WaveGen-Studio to store pointers to acquisition files; configuration and other data. All of the metadata (project data) entered by the user is stored in this database. The structure of this metadata is described in the reference section. The first time that WaveGen-Studio is connected to a server, it retrieves the hardware capabilities of that server (as either a DAQ or a CTRL server) stores this information in the database and allocates the server to the correct server page. The user can now access and use the server.

The New DAQ Database option in the FILE pull-down menu allows the user to create a new database. This step is required the first time that WaveGen-Studio is run or whenever the user wants to overwrite the existing database with a new one.

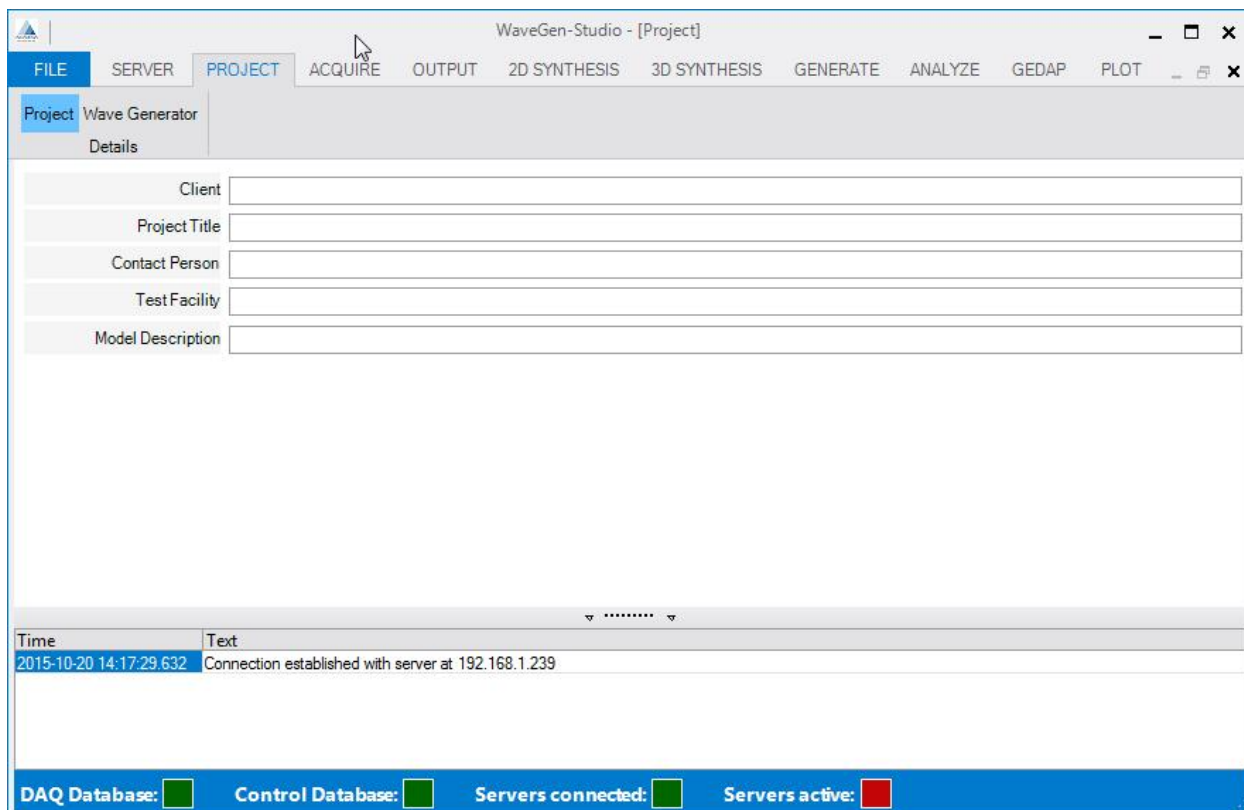
Use the FILE → New DAQ Database Option to create an empty DAQ database. When the database is created successfully the message “Empty data acquisition server database created.” is displayed in the message window and the DAQ Database indicator turns green.

WARNING! The contents of a previously existing database (.DAQ) and its associated data files (.AQD) will be lost at this point. To retain an archive of this dataset navigate to c:\ProgramData\Akamina\WaveGen-Studio and copy the WaveGen-Studio.DAQ file and all files with an AQD extension (for example: Server 1_20151030-153127.AQD) to your backup medium.

The creation and use of a Control Database is described in the Starting a Wave Generation project on page 41.

Identifying the Project

Enter data identifying the project through PROJECT →Details →Project option. Data entered here is saved as it is entered, becomes part of the metadata section of any exported data file and can be modified at any time.



Time	Text
2015-10-20 14:17:29.632	Connection established with server at 192.168.1.239

DAQ Database: ■ Control Database: ■ Servers connected: ■ Servers active: ■

Figure 9: New Project Interface

Add and Configure the Servers

After physically connecting the servers to your LAN, they need to be discovered and their hardware capabilities identified. This is done through the SERVER →Add Server button shown in Figure 11. The Server interface has two pages - one for DAQ servers and one for CTRL servers. Each page has two sections: one that affects all the servers:-the All Servers section and one that is server specific:-the Server Grid section.

Adding Servers

The All Servers section includes the Server Type selector pull down and the Add Server; Connected status and Active status buttons. These buttons enable the user to add servers that may become part of the data acquisition or control session and provides for master control of all of the servers in the grid.

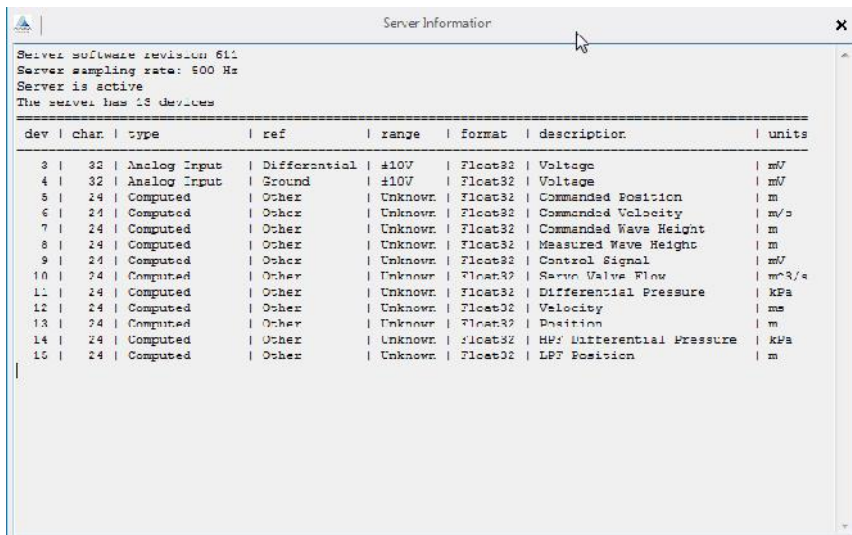
- **Server Type** - A master control for selecting the type of server to be added, or displayed in the Server Grid section.
- **Add Server** - Allows the user to add a new entry for a server in the database. A new server will appear in the ServerGrid below. By default the following values will be assigned:
 - a Server index of value X, where X is incremented each time a server is added to the database,
 - a Server Name : Server X, where X is the Server index , and
 - an IP Address: (default: 192.168.1.30). (Changing a server's IP address is described on page 53).

- **Connected Status**- A master control for connecting all the servers currently listed in the Server Grid. Pressing this button will simultaneously connect/disconnect all servers.
- **Active Status**- A master control for simultaneously activating/deactivating all the servers currently listed in the server grid. When the status shows Active (green), the servers are sampling data at the maximum rate from all channels; if the Active status is Not Active (red), the servers are not sampling. If the Active button is in a faded colour it has been disabled. See page 23 for a description of the behaviour of Active or Not Active servers.

Configure a Server

Below these buttons is the Server Grid section containing information on and control of individual servers. The Server Grid has a row for each server including information about a server and some control capabilities for that server. The columns in this section are listed below:

- **Type** - the server type. When a server is added its' type is determined by the Server Type field setting. When a connection to the server is established, the server's hardware capabilities are retrieved and compared to the demanded type. If the type differs, the newly connected server will be added into the correct Server page: DAQ or CTRL. The maximum number of each type of server that can be used is defined in the License file.
- **Server Name** - the name assigned to the server. This field is editable at any time. Server selection and the base of the file name used for acquired data all use the server name so a name other than the default Server n is recommended.
- **IP Address** - the current IP address of the server. This is the IP address that the user interface uses when it connects to the server. Editing this field when the Server is in a disconnected state results in the WaveGen-Studio looking for this server at the new address the next time that it attempts to connect; editing this field with the Server is in a connected state results in the IP address of the server being changed.
- **Connected (button)** - this button allows the user to manage the TCP/IP connection with the server.
 - If the button is green with the text 'Connected', the client and the server are connected. In this case, pressing on the button will cause the client to close the connection with the server.
 - If the button is red with the text 'Disconnected' the client and server are not connected. In this case, pressing the button will cause the client to attempt to establish a connection with the server at the shown IP Address. See further explanation in Connecting/Disconnecting to a Server on page 22.
- **Max Rate** - defines the sample rate for the server. The number shown is server dependent.
- **Actuator Range** - (CTRL servers only). Shows the number of actuators attached to this server.
- **Delete (button)** - removes the associated server from the list of valid servers.
- **Upgrade (button)** - upgrades the software running on the associated server with an Akamina server upgrade file.
- **Show (button)** - displays important configuration information obtained from the server. This information includes information on the server input devices.

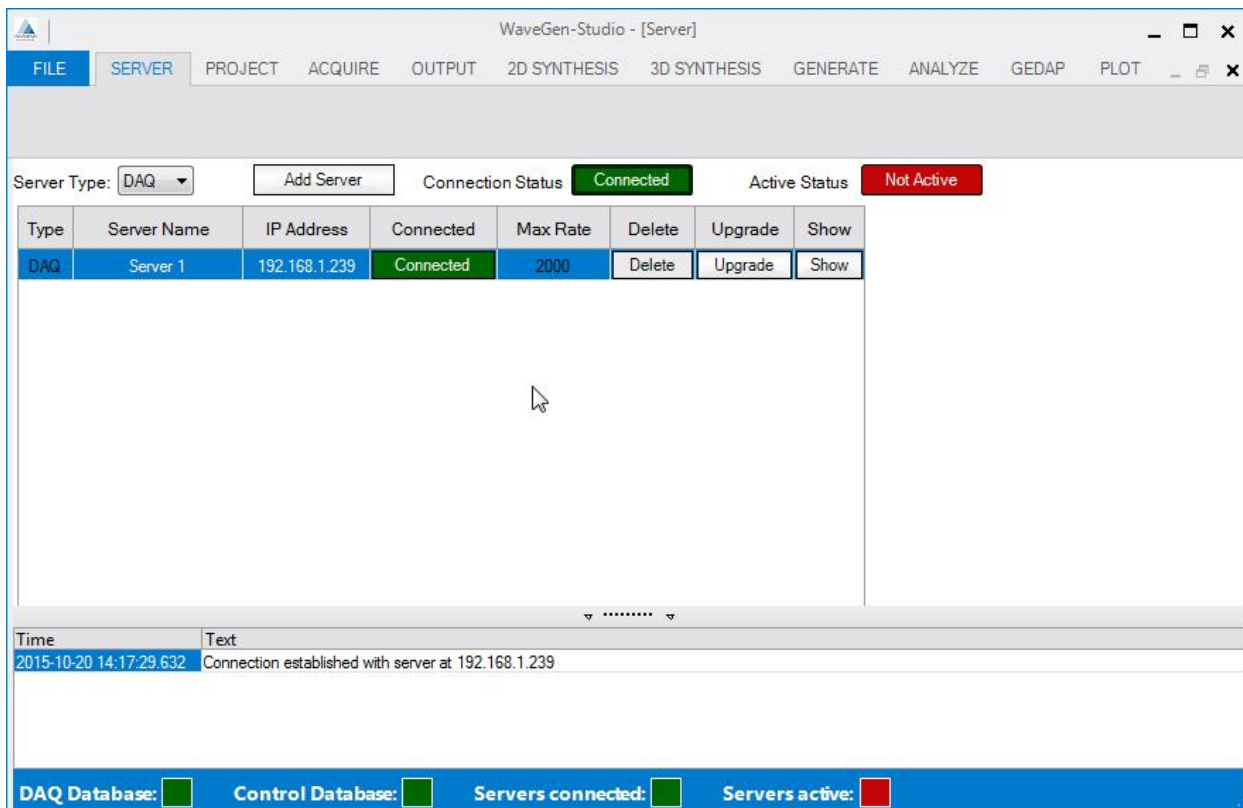


Server software revision: 611
Server sampling rate: 500 Hz
Server is active
The server has 15 devices

dev	chan	type	ref	range	format	description	units
3	32	Analog Input	Differential	±10V	Float32	Voltage	mV
4	32	Analog Input	Ground	±10V	Float32	Voltage	mV
5	24	Computed	Other	Unknown	Float32	Commanded Position	m
6	24	Computed	Other	Unknown	Float32	Commanded Velocity	m/s
7	24	Computed	Other	Unknown	Float32	Commanded Wave Height	m
8	24	Computed	Other	Unknown	Float32	Measured Wave Height	m
9	24	Computed	Other	Unknown	Float32	Control Signal	mV
10	24	Computed	Other	Unknown	Float32	Serve Valve Flow	m³/s
11	24	Computed	Other	Unknown	Float32	Differential Pressure	kPa
12	24	Computed	Other	Unknown	Float32	Velocity	mm
13	24	Computed	Other	Unknown	Float32	Position	m
14	24	Computed	Other	Unknown	Float32	HPT Differential Pressure	kPa
15	24	Computed	Other	Unknown	Float32	LPT Position	m

Figure 10: Show Server Information

Add one or more servers and connect to each verifying their connected indicator turns green.



WaveGen-Studio - [Server]

FILE SERVER PROJECT ACQUIRE OUTPUT 2D SYNTHESIS 3D SYNTHESIS GENERATE ANALYZE GEDAP PLOT

Server Type: DAQ Add Server Connection Status: **Connected** Active Status: **Not Active**

Type	Server Name	IP Address	Connected	Max Rate	Delete	Upgrade	Show
DAQ	Server 1	192.168.1.239	Connected	2000	Delete	Upgrade	Show

Time: 2015-10-20 14:17:29.632 Text: Connection established with server at 192.168.1.239

DAQ Database: [green] Control Database: [green] Servers connected: [green] Servers active: [red]

Figure 11: Setup Server Interface with one DAQ server added

Connecting/Disconnecting to a Server

There are 2 ways to connect/disconnect to/from a Server. The user can use the:

- Connection Status button in the All Servers section to disconnect all connected servers of the selected type (DAQ or CTRL), or the
- Connected Status button to disconnect a specific server.

In either case, after a successful execution of either of these options:

- The status on the server line will toggle from 'Disconnected' to 'Connected' or 'Connected' to 'Disconnected' and
- A message indicating 'Connection Established with server at xxx.xxx.xxx.xxx' or 'Connection with server at xxx.xxx.xxx.xxx closed.' will be displayed in the Message Window.

Note: Whenever the state of the connection to the server switches to 'Connected' the information about the server is sent to the database and saved.

Active/Inactive Servers Explained

When the servers are set to Active on the Setup page, they start to sample data at the maximum rate from all channels. This data is stored in the individual server's internal buffer (note, this sampled data is not stored in and AQD file at this time). Before this data can be considered meaningful, the sensors must be assigned to channels; the channels set to the Active state; the server channels must be calibrated and the data acquisition started. It is the start of data acquisition that begins the transfer of data from individual server's internal buffers to WaveGen-Studio.

Note:

- When the servers become active, data is sampled and stored in each server's internal buffer regardless of whether or not any sensors are attached.
- If the channel is analog and its Active status is Active but it is not connected to a sensor, the data will typically all be zeros.
- If the channel is in the active state on a CAN Bus but has no connector attached the data will all be zeros.

Servers, Devices, Channels, CAN Bus and Sensors explained

Servers

WaveGen-Studio uses two types of servers: Acquisition servers [DAQ] for the management, control, and recording of waveform data from a variety of analog and digital sensors and Control Servers [CTRL] for the setup and management of wave generation equipment. Control Servers contain a number of acquisition channels which are managed, controlled and recorded in the same way as their Acquisition server counterparts. The number of servers of each type that can be used at any one time is specified in your WaveGen-Studio License.

Devices

A Device provides a user with a number of the same type of inputs or outputs. An example of a device can be an 8-channel Analog input module, a CAN Bus interface or a digital output. Each of the following is a Device and, if installed on your server, will be given a different Device #. Device numbering proceeds with no gaps, if a module or card is not installed, the device numbering continues with the next available item.

- | | |
|------------------------------------|--|
| • A Counter | always Device #1 only one per Server. |
| • A Timing error | always Device #2 only one per Server. |
| • Up to six Analog Input devices* | one Device # per installed Analog input device. |
| • Up to eight CAN Bus interfaces | one Device # per installed CAN Bus. |
| • Up to two Digital input devices | one Device# per installed Digital input device. |
| • Up to twenty Computed devices | one Device# per type of computed value. |
| • Up to two Analog output devices | one Device# per installed Analog output device. |
| • Up to two Digital output devices | one Device# per installed Digital output device. |

*An analog input device can be any of: and analog input; a strain gauge input or a counter input.

Channels

The maximum number of input channels that can be acquired is 255. Channels marked as DISABLED will be excluded from further configuration and acquisition efforts thereby reducing the number of channels to be considered. To calibrate a channel and use it for acquisition, set it to ENABLED.

CAN Bus

CAN Bus is a digital serial bus that allows compatible sensors to be organised and managed through daisy chained architecture. Up to 30 sensors can be attached on each CAN Bus with each sensor identified by its serial number. Sensors respond to broadcast queries from the server and forward data and ID to the server according to an algorithm derived from their serial number to avoid bus conflicts. During the setup of the digital sensors, (see Using AWP-300 Sensors on page 53) a query sent from the server identifies all sensors on the bus and provides a list to the user for linkage to a channel number. Up to two CAN Bus interfaces may be provided on the (ADQ-1000) server.

Sensors

Digital sensors are connected in a daisy chain manner on one of the available CAN Bus connections. Each sensor has a serial number which both identifies it and specifies its' physical location. This serial number is collected by the WGS when the sensors are discovered (detected) and is presented to the user in a pull down table to allow the user to associate a serial number with a particular channel. Each allocation of a serial number to a channel causes the channel number to increment and the list of available sensors to decrease. This one to one linkage of serial number to channel number eliminates the need to include the serial number in the specification of this input: the channel number / device type combination is sufficient.

Analog sensors are connected to one of the analog inputs provided on the system. These are identified by their AIN #, which is used as the Channel number by the server for this input. The content of the serial number field is not used by WGS but including the serial number here can provide a useful cross reference to the input sensor's physical location.

Summary

In the case of digital sensors the association by the user of the sensor's serial number to a channel provides a unique identification of that input to the WGS. Subsequently the combination of Channel # and Device Type is sufficient to uniquely identify this input.

In the case of analog sensors, the one-to-one physical connection through the server front panel provides the unique Channel # Device Type linkage specifying this input.

Manage the Channels

The ACQUIRE → Setup → Channels interface allows you to manage the channels available on the server for later configuration and data acquisition.

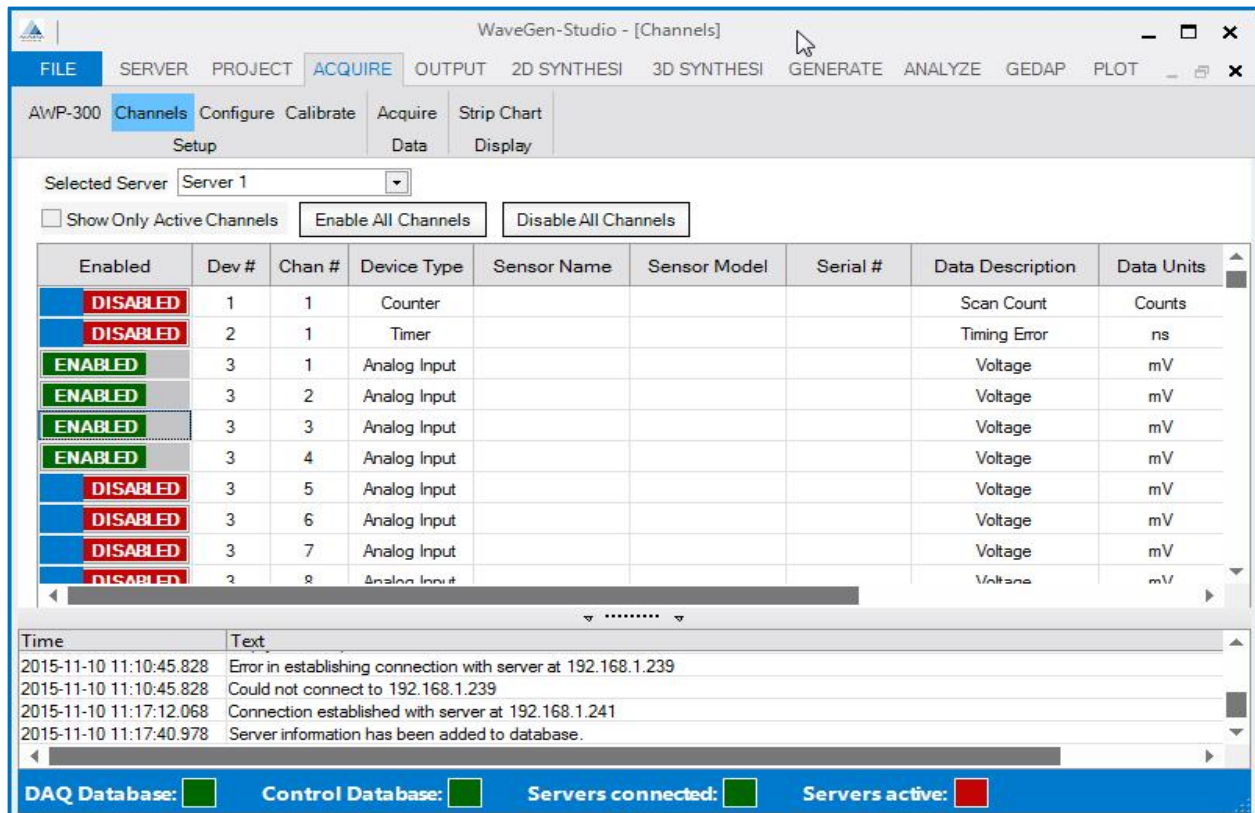


Figure 12: Manage Channels

Additional sensor specific information can be added and a subset of all the assigned channels can be identified. These identified channels are the only ones that will appear in the next step ACQUIRE → Setup → Configuration. An example Channels window is shown in Figure 12.

Choosing the Server

Use the Selected Server pull down menu option to select which server to work on.

Show only Active Channels

A Show Only Active Channels checkbox is used to specify whether all of the channels available will be included in this display or only those channels that have been set to ENABLED. The Channels window with Show Only Active Channels checked is shown in Figure 13.

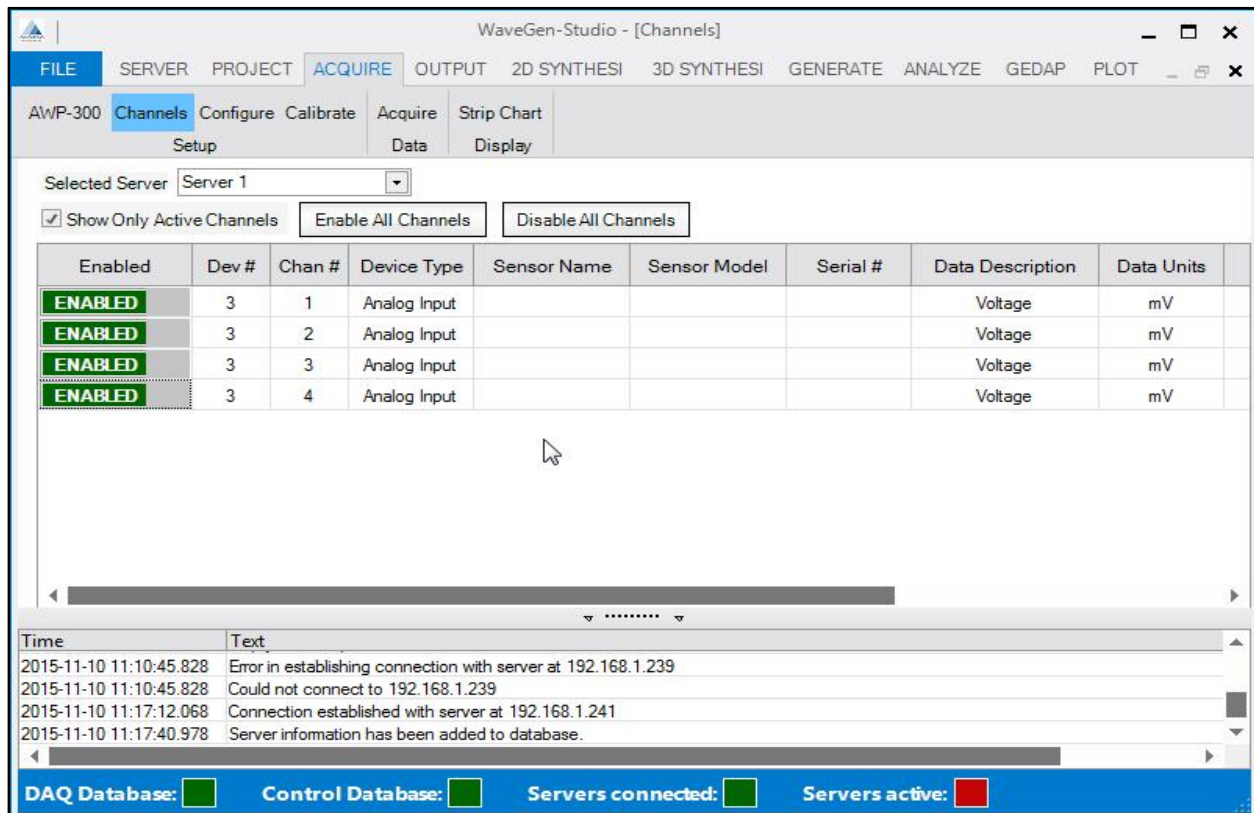


Figure 13: Setup Channels showing Enabled Channels Only

The channel information is arranged in a 2-D matrix with the information for each individual channel in one row. The data columns from left to right are:

- **Enabled** - this is a slider that is used to make a channel available for selection in the ACQUIRE → Setup → Configure interface. For the channel to be available set the slider is ENABLED; otherwise it has the value DISABLED.
- **Dev #** - a read-only device number assigned by the server.
- **Chan #** - a read-only channel number on the device assigned by the server.
- **Device Type** - a read-only device type specified by the server.
- **Sensor Name** - a user-definable name assigned to the sensor.
- **Sensor Model** - a user-definable text field assigned to the sensor.
- **Serial #** - for CAN Bus connected sensors, this field is read-only since the ACQUIRE → Setup → AWP-300 interface is used to assign sensors. For all other device types, this is a text field that can be entered by the user.
- **Data Description** - an editable text field to specify the type of measurement that is made by the sensor (e.g. Wave Elevation).
- **Data Units** - an editable text field to specify the measurement units (e.g. cm).
- **Calibration** - Shows the formulaic expression of the calibration of this channel. This field is editable in a pop-up window accessed with a double-click.
- **Last Calibrated** - read-only date/time field that indicates the date on which the sensor was last calibrated. The field is null if the sensor has never been calibrated.
- **Cal Group** - an editable integer field that specifies the calibration group that the sensor is to be part of. Group numbers can be 0 for unassigned or 1 through 4 for groups 1 through 4.

Complete the details for the sensors to be used.

Configure the Channels

When set to active, the server continually samples all of its input channels at its maximum acquisition rate - typically 1000 samples per second. The ACQUIRE → Setup → Configure interface is used to select the subset of server channels from which data is to be acquired and the inter-sample spacing of the data.

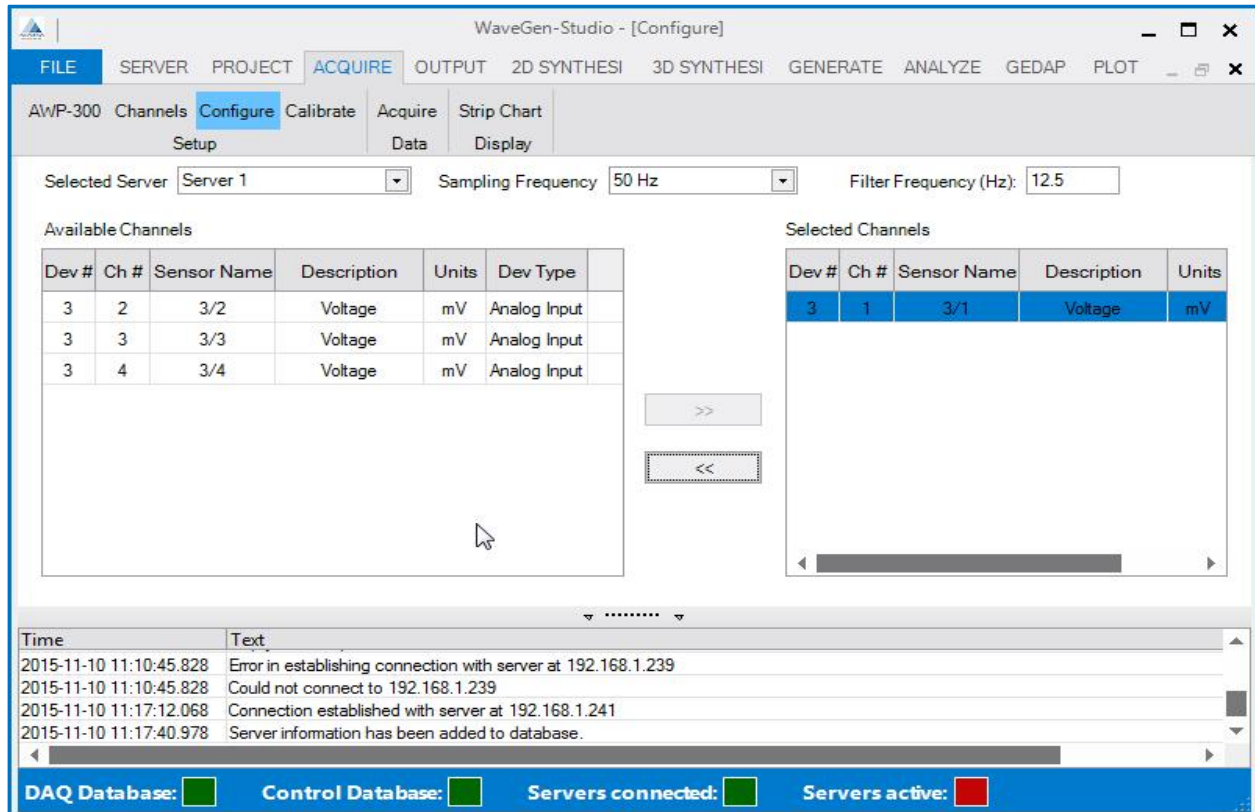


Figure 14: Configure Channels

These selected channels are the channels which will be available for eventual data acquisition via the ACQUIRE → Data → Acquire interface. An example configuration window is shown in Figure 14. The user defined elements in the window are:

Choosing the Server

Use the Selected Server pull down menu to select from a list of configurable servers.

Selecting the Sampling Frequency

Sampling Frequency - this is the selected sampling frequency for data acquisition and is server dependent with the maximum rate between 500 and 10,000 samples per second. The rate is selected via a drop-down list that shows the sampling frequency options for the selected server. The supported sampling rates range from 0.01 Hz up to the maximum determined server rate.

Selecting the Filter Frequency

This is the cut-off frequency expressed in Hz to one decimal place of the second-order digital low pass filter applied to all analog input channels. To disable filtering, set this value to '0' or the maximum sampling rate of the server.

Available Channels List

The left hand pane provides a list of channels that are available for data acquisition if selected. A channel must be set to ENABLED in the Acquire Setup Channels interface to be available here for selection. As channels are selected for data acquisition, they are removed from this list and moved to the Selected Channels List.

Selected Channels List

The right hand pane provides a list of the channels that have been selected for data acquisition. To control movement of channels between the two panes use:

- >> Button - this button moves the selected channel(s) from the Available Channels list to the Selected Channels list. The button is only enabled if a row or rows in the Available Channels list has been selected.
- << Button - this button moves the selected channel(s) from the Selected Channels list to the Available Channels list. The button is only enabled if a row or rows in the Selected Channels list has been selected.
- Double-click - a double-click in any row of either pane will move the channel to the other pane.

Select the Channels for Calibration

The ACQUIRE Setup Calibrate interface is used to select a shortlist of channels for calibration from the list of channels made in the ACQUIRE → Setup → Channels step. Any channels selected in a shortlist are calibrated at the same time and have the same reference values.

The window layout (see Figure 15) and controls available and use are the similar to those in the Configure window, except:

- A **Display Channels** pull-down enabling the appropriate group of channels to be selected replaces the Sampling Frequency, and
- The **Show Only Active Channels** checkbox is available. If Show Only Active Channels is selected, a channel must be set to ENABLED in the ACQUIRE → Setup → Channels interface to be available here.
- A **Calibrate** button launches the Collect Data for Calibration window.

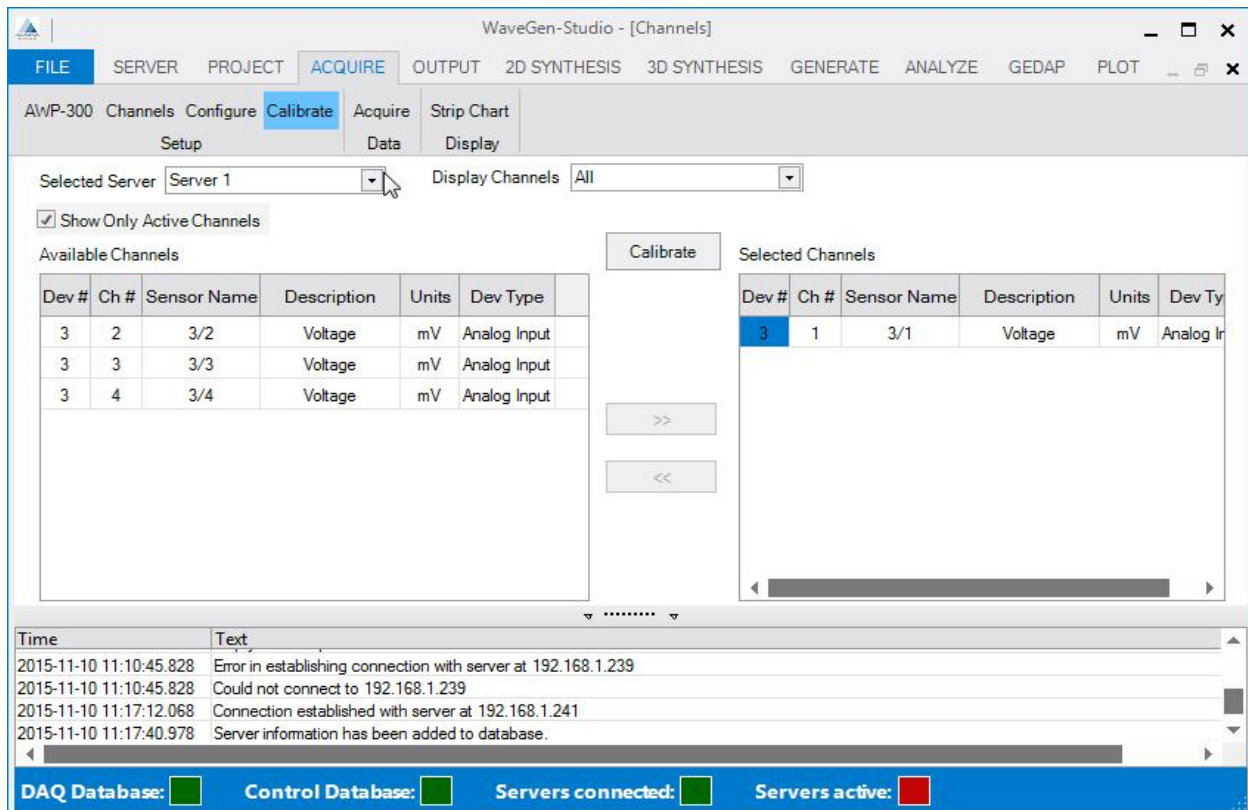


Figure 15: Calibrate Channels

Collect and Manage Calibration Data

The Collect Data for Calibration window launched by the calibrate button and shown in Figure 16 is used to collect and manage the data needed for calibration. The window contains the following elements:

- **Operation**-this is a pull-down menu that is used to specify the calibration operation. The options available are: New Calibration, New Re-Zero and View Calibration.
- **Sampling Time**-this is length of the sample time for each data point in a calibration or a re-zero. It is an integer input box with increment and decrement buttons. The minimum sampling time is 1 second and the maximum is 600 seconds.
- **Channel Navigation**-this is the standard set of «, <Prev, Next> and » options to move to the first, previous, next and last in the list of channels that are having the selected operation performed on them.
- A **Channel Information** box appears below the Channel Navigation controls. Information on the selected channel is displayed in this area.
- A **Plot Area** appears below the Channel Information box. The data points in a calibration, the calibration curve, and the re-zero curve are displayed in this area. In the example window shown in Figure 16, the message Insufficient data to plot is displayed indicating that there are not enough data points to compute a calibration curve.

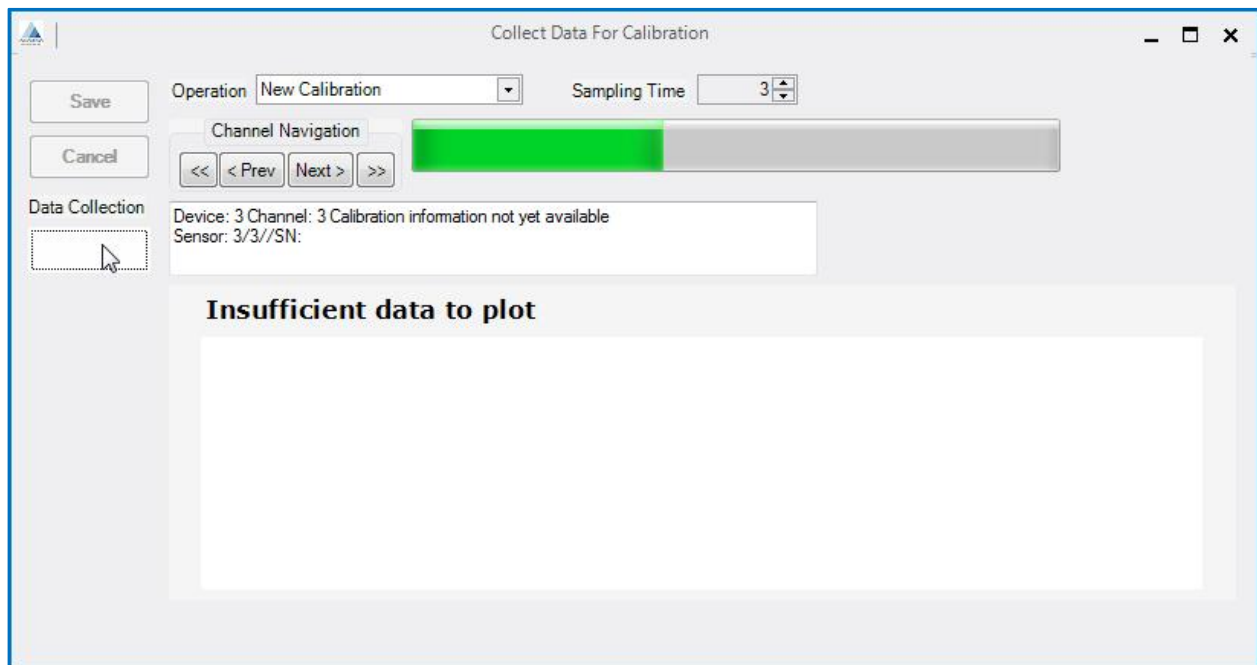


Figure 16: Calibration Window Collecting Calibration Data

Along the side of the window there are buttons for the user to manage the calibration data. They buttons are:

- **Save** - this button allows the user to commit the updated calibration or re-zero information to the database. Until the Save button is pressed, no permanent changes to the database are to be made. The Save button is inactive until at least two points are acquired in a calibration procedure or until re-zero information has been acquired.
- **Cancel** - this button allows the user to discard all of the calibration or re-zero information acquired or computed since the last Save. If the Save button is active when Cancel is selected, the user is warned that recent changes will be lost and asked to confirm that they wish to cancel the changes.
- **Data Collection Start & Stop**- this button is used to start and stop the acquisition of raw data for calibration. Data Collection will start when the button is pressed; data collection will stop when the button is pressed a second time or after the Sampling Time has elapsed. The button displays START when not acquiring data and ready to start; and STOP to cancel the collection.

A progress bar also appears to the right of the Channel Navigation controls while data are being acquired. Once the acquisition is complete, an Acquired Calibration Data window opens to display the statistics of the acquired data and to allow the user to enter the reference value to be associated with the data point(see Figure 17).

Note: the user must provide a reference value; a numeric value with up to 3 decimal places.

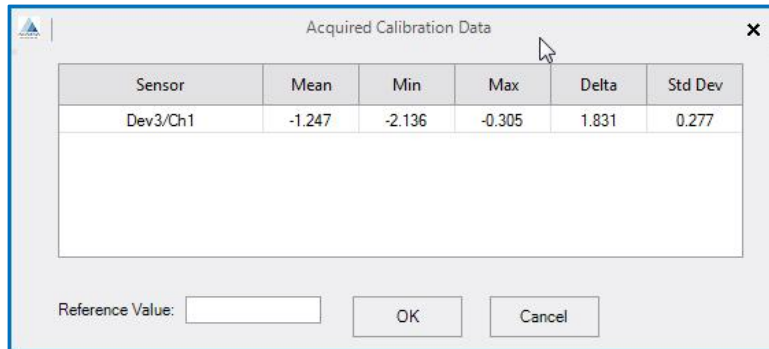


Figure 17: Acquired Calibration Data Window

Support has been added to edit the data points acquired during calibration. To edit a data point, double-click on the data point to be edited in the graph in the Plot Area. An Edit Reference Point pop-up will appear with a data point for editing as shown in Figure 18. This pop up shows the statistics for the acquired data as well as the reference value and best fit value. The reference value for the data point can be changed or the data point can be deleted; no other edits are possible. Data points can only be edited during calibration.

An example calibration procedure is shown in the Reference section on page 68.

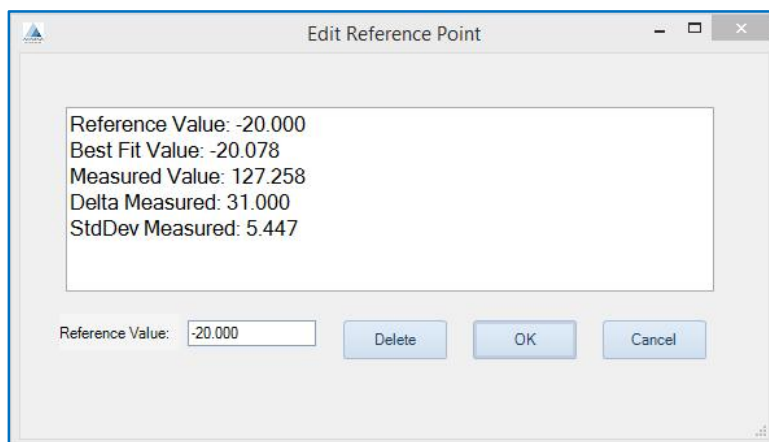


Figure 18: Edit Reference Point Window

Acquiring the Data

During the Data Acquisition phase, the sampled data is acquired and stored in WaveGen-Studio's AQD files. After data acquisition is complete the user can export the data using the FILE → Export command as described on page Figure 47.

The ACQUIRE → Data → Acquire interface, shown in Figure 19, is used to select a server type from the drop down list from which to collect data. When a type is selected and the Open Acquisition Interface button is clicked a pop-up window appears that allows the user to start, stop and monitor the acquisition progress for all servers of the same type (DAQ or CTRL) (see Figure 20).

A second window can be opened concurrent with the first to perform data acquisition on the other server type by repeating the steps above, and selecting the alternate server type.

Note: the Open Acquisition Interface button is only enabled if the selected server type is active.

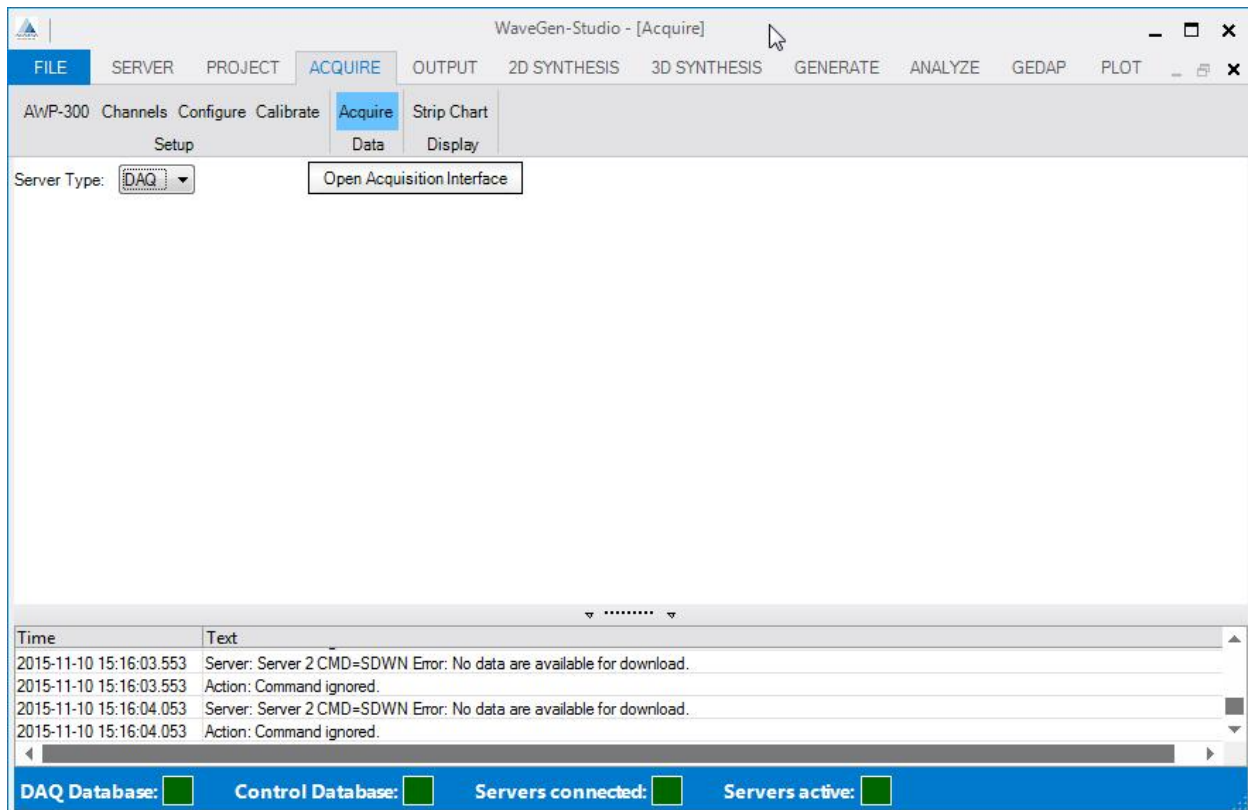


Figure 19: Acquisition Launching window (DAQ server)

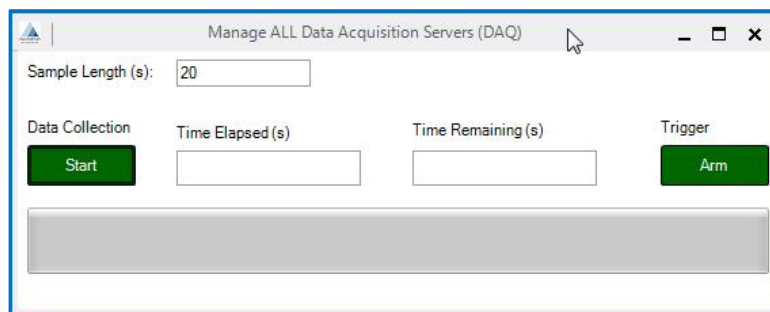


Figure 20: Manage Acquisition window

The Manage Acquisition pop-up window is specific to a server type; the server's type is prefixed to "Manage ALL" at the top of the pop-up window. This interface provides for control of an acquisition session. The session length can be specified, then started and stopped. Monitoring is provided by a progress bar and by two numeric indicators that show the amount of time of the session that has elapsed and the amount that is remaining. The Manage Acquisition window will remain open until it is manually closed.

- **Sample Length (s)-** the length of the sampling period, in seconds, is specified in this field. This is an editable field.
- **Data Collection** - a button used to start and stop data acquisition. The button shows Start when collection is ready to start. After pressing the Start button it changes to Stop. Data acquisition is stopped by pressing the Stop button or waiting for the sampling period to complete.

- **Time Elapsed (s)** - a read only field. It shows the number of seconds that have elapsed since data acquisition was started. Alternatively it will have the value "Done and Saved" when an acquisition session has ended.
- **Time Remaining (s)** - a read only field. It shows the number of seconds remaining in the data acquisition. When the acquisition is completed, the message "Done and Saved" is displayed in the field.
- **Progress Bar** - a progress bar showing the percentage of the data acquisition period that has been completed (read only).
- **Trigger** - a button labelled ARM which when pressed allows a remote trigger to start the data acquisition. When armed, a level change from 0v to +3v on analog input 1 will start data acquisition.

When the acquisition is finished as a result of either the Stop button being pressed or the acquisition time period has run to completion, the Time Remaining display will be updated to "Done and Saved" indicating that the data acquisition system is finished (Done) and the data has been saved in the AQD file (Saved). At this time the User can use the FILE → Export command to view the results of the acquisition session. The user cannot use export prior to a session ending.

Whenever the Start / Stop Button is pressed, the fact that a data acquisition system has been started / stopped is recorded in the Message Window section of the WaveGen-Studio window.

Although the Manage Acquisition window remains open until manually closed, WaveGen-Studio allows the user to access the main WaveGen-Studio interface. This allows the user to look at strip charts, etc.

Displaying the Data

There is only one Option, Strip Chart, under the Display Activity. The Strip Chart interface allows data from one or more channels to be displayed in real time. Strip Chart is only enabled if the selected server is active.

Each strip chart shows the last user selectable (default length is 60s) length of data acquired from the channels selected for display. The data are sampled at 20 samples per second and the strip chart is updated 4 times per second (less frequently as the processing load increases). The range of the y-axis of a strip chart is updated continuously to display the data in the maximum detail. Data are plotted in acquired data units or in Calibration Units, by using the checkbox.

Typically servers support up to 11 active acquired data sessions with the client. Each strip chart uses a single acquired data session making 11 the maximum number of simultaneous strip charts that can be displayed. Calibration also uses an acquired data session so if calibration and strip charts are all to be active simultaneously, the maximum number of strip charts is limited to 10.

An example strip chart configuration session is shown in Figure 21. The user managed selections are shown at the top:

- **Selected Server** - a drop down list of available servers. Only active servers are shown in this list.
- **Strip Chart Length** - Enter the required length (in seconds) for the Strip chart display.
- **Available Channels** - the list of channels that are available for inclusion in a strip chart (left side).
- **Selected Channels** - the list of channels that have been selected for inclusion in a strip chart (right side).
- **Create Chart button** - a push button used to create a strip chart that includes the selected channels.
- **Use Calibration Units** - a checkbox - converts the data to calibration units before displaying the data.

Movement of channels from the Available Channels list onto the Selected Channels list follows the previously described methods.

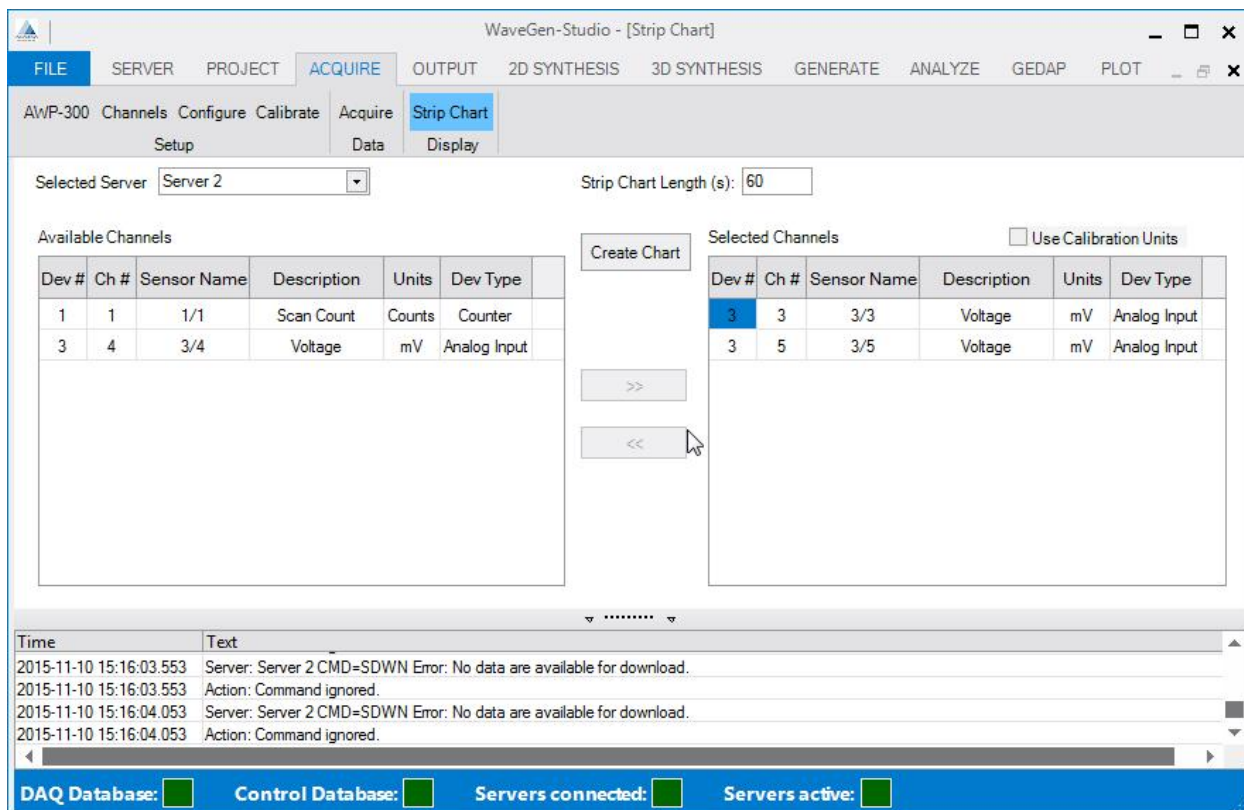


Figure 21: Strip Chart Configuration window

An example strip chart from an AWP-300 showing bit noise is shown in Figure 22.

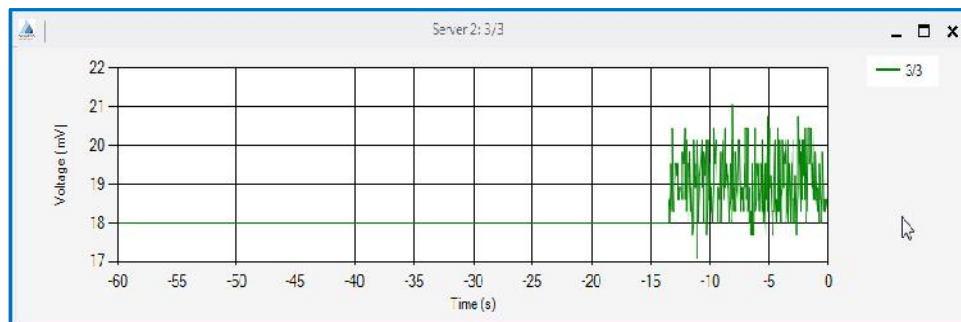


Figure 22: Strip Chart Showing Bit-Noise on One Channel

An example strip chart showing an analog input channel with a wave height gauge attached is shown in Figure 23. The portion of the strip chart where the gauge is raised and lowered in water can be clearly seen in the figure.

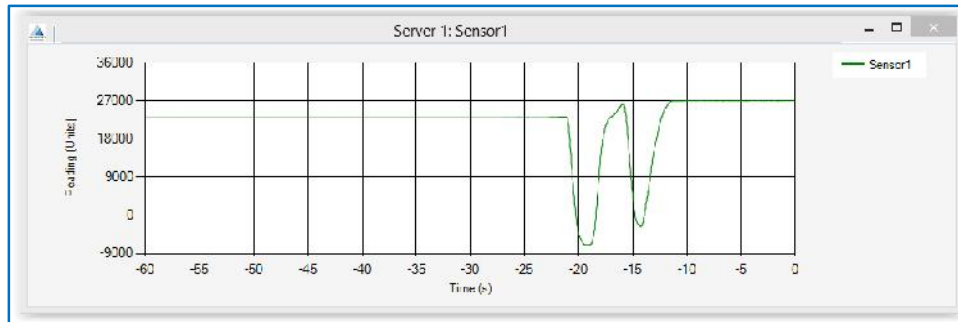


Figure 23: Strip Chart Capturing Water Level Changes

Analyzing the Data

The Options included under the ANALYZE tab enable the user to analyze the data acquired. The Activities provided by Analyze are listed below with a summary of the functionality that they provide. A detailed explanation of the analysis type performed, the algorithms used and any restrictions applicable to this option are available by selecting the option and then pressing the Help button.

Time Domain

Includes time-domain implementations of:

- Low-pass filter and high-pass filter, and
- Differentiation.

Frequency Domain

Includes frequency-domain implementations of:

- Low-pass, high-pass and band-pass filters,
- Integration and differentiation, and
- Variance spectral density.

Reflection Analysis

Implementations of:

- Reflection Analysis
 - 3 probe/5 probe analysis
 - 3 probe separation

Statistics

Basic statistical analysis of GEDAP data files.

Data Manipulation

Basic data manipulation including:

- Extract - extract information from a data file
 - Select - select a range of data samples from a file based on time
 - Resample - resample a data file at a different sampling frequency
 - Decimate - time domain decimation of data
- Modify
 - Repair → Smooth → GEDAP smoothing
 - Transform
 - ❖ Scale - scale a data file
 - ❖ Transform - transform the data using an equation $y = mx + b$
 - ❖ Trend - add or remove trends from a data file

- ❖ **Vector Math** - manipulate multiple data files using vector mathematics

Utility

Utility - file based functionality to:

- Export a data file in csv format.
- Import a csv formatted file.

Creating and using Macro Commands

Only one option - Tools is available on the GEDAP tab. This tab allows you to create and play pre-recorded sequences of actions involving GEDAP programs. Four controls are available in the banner: Play; Record; Stop and Save, in addition the pull down box allows selection of New or Open.

Creating a New Macro

Choosing New causes any active recording of actions (macro) to be deleted and the Studio to prepare to record a new series. The recording of the actions will start with the Record button and continue until this tab is accessed again and the Stop button is clicked. In between these events any action that calls or operates a GEDAP program available through WGS, including the setting of parameters and definition of limits for such a program is recorded and stored in a temporary file. This file can be saved or renamed and saved as a GBAT file in the folder of your choice.

Macro files so created can be edited with any text editor such as Notepad.

Using an Existing File

Choosing Open allows you to browse to a directory and select a macro file for replay. Any DOS batch or command file in addition to GBAT files can be played.

Using Plot

Limited plotting capability is available under the PLOT tab (see Figure 24: Plot tab showing a PlotFigure 24). This is intended to be used for a visual display of one or more GEDAP data files. Multiple files can be overlaid and interactive zooming is possible. The GPLOT package is available if more advanced plotting capabilities are desired.

The Options available under the PLOT tab include:

- **Add File** - select the files to be plotted, one file at a time,
- **Clear List** - clear the list of files to be plotted and clear the plot area, and
- **Plot** - plot the list of files that have been added to the list using the Add File.

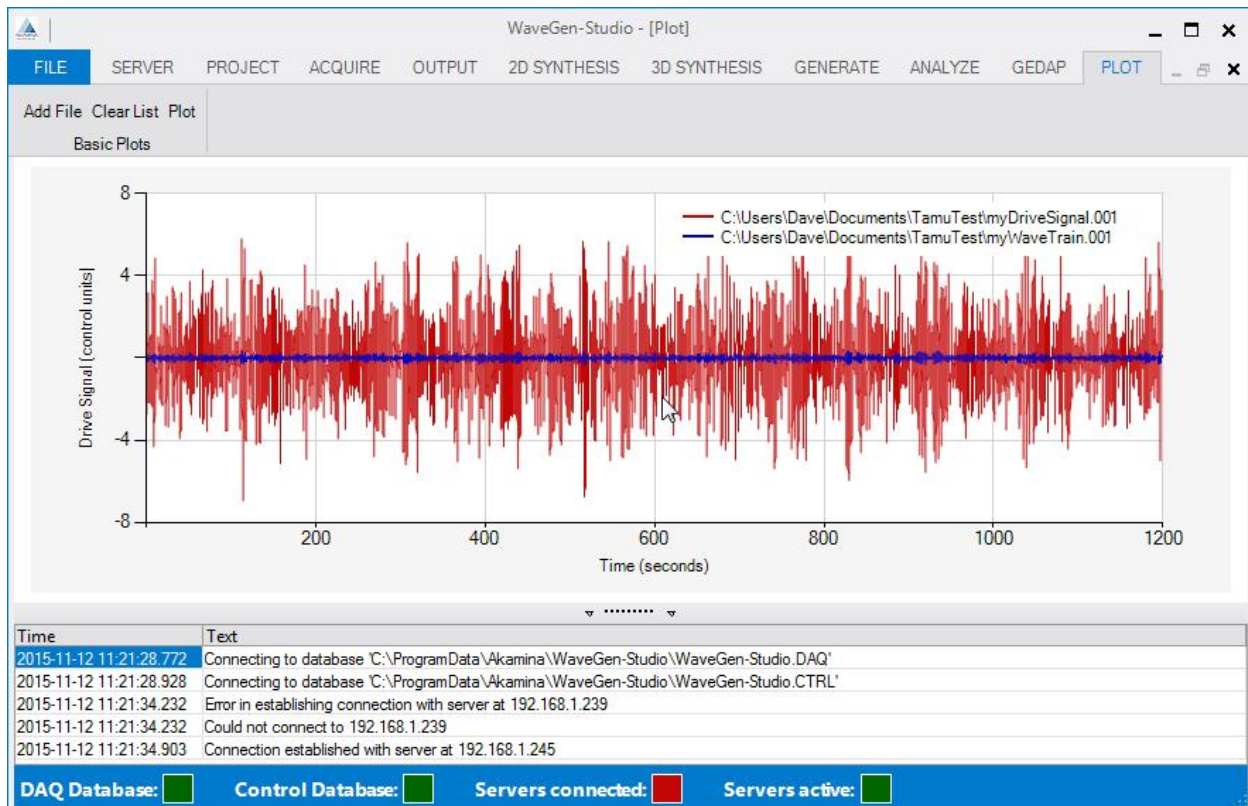


Figure 24: Plot tab showing a Plot

Using Outputs

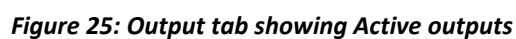
No options are available under the Output tab. This tab allows you to play previously created GEDAP files through a selectable analog output independently from any other analog output or to change the output level of a digital output from a user controlled button. Typically up to thirty two Analog or eight Digital Outputs are available on suitably configured and licensed DAQ servers. A GEDAP data file of voltages, specified in mV, can be loaded into each output channel and each channel can be individually scaled. All analog output starts, stops and scale changes are ramped over a period of 10 seconds. The presence and type of outputs can be seen by clicking the Show button of the server in question in the WaveGen-Studio [Server] window, Figure 1 and they appear sorted by device and channel number when the OUTPUT tab is opened.

Setting up an Analog Output

To access and play a file on an output:

1. Open the OUTPUT tab
2. Choose the server with the outputs to be activated from the Selected Server pull-down. **Note:** if you select a server with no output capability, this page will remain blank
3. Uncheck the Show Only Active Channels checkbox to show all available outputs on the selected server
4. Select the output required and slide the enabled slider from DISABLED to ENABLED
5. Click the Load button, and select the GEDAP file to be played in the Windows™ pop up. Once a file is loaded, the Load button changes to Clear, to allow the file to be deleted or replaced
6. Double-click the Scale field and rescale this output from 0 to 1 (where 1 is untouched) if required
7. Repeat for more outputs if desired (see Figure 25)
8. Click the Analog Output (Stopped) button to commence playing all active outputs
9. Play out can be halted at any time with the Stop button

- Note:** To affect this output the Scale value must be applied by clicking the Apply button. The Scale value is stored by WaveGen-Studio however and will reappear against this output the next time that the OUTPUT tab is opened whether Apply (ed) or not.



Digital outputs are manual and are effective immediately when the button is depressed. Outputs can be set High or Set Low. The current level of the output is shown adjacent to the button.

Using the Interface

The graphical wave synthesis interface provides direct access to the GEDAP 2D and 3D wave generation packages. Selecting an option launches a graphical interface to the function chosen in the main window. At the top of this window, the help button provides access to the GEDAP help file containing additional notes and explanations for the chosen GEDAP program. On the right hand side a slider permits scrolling through longer parameter lists contained in the middle of the window. Tool tips are used to clarify limits, restrictions, choices and the units used in each of the input fields. Input and output calibration or control files can be created or accessed using the pull downs.

Using Multiple input Files

A number of commands in Analysis and Synthesis (see list below) are able to perform the requested task on multiple input files sequentially. This function is selectable through the Auto-repeat checkbox and entering the number of files to be treated in the Max field. These fields are not present when the window opens initially. Enter an Input File and click elsewhere in the window to start the process to determine if the selected command has this feature.

The commands that have this feature are in:

- **BasicDataAnal** package: Decimate, Deriv, Diff, Filt_FFT, FiltK, Resample2, Scale, Select1, Stat1, Transform1, Trend2, VMath and VSD.
- **AdvDataAnal** package: ZCA.

These fields only show up if:

- the command allows auto-repeat (the command is on the list above)
- An input file has been specified.
- The input file has a numeric extension (like .004).
- There is another file with the same base-name and a numeric extension one higher than the given one. The Max field will show the total number of adjacent, but higher files, so if the user specified file.003 and the file range is from file.001 and file.005, then the integer field will show 3 (files 3, 4, 5).

When the program is executed with the auto-repeat enabled, then all files will be processed and the Display Program Output will show the correct contents. The plot will show only one file, the named one.

When the input is complete, check the Display Program Output box if required and commence the operation with the Compute button. The GEDAP Output window opens showing the program chosen, the output file path/name and the parameters used in this synthesis. Click the OK button to show the output plot.

2D and 3D Capabilities

The interface allows spectra to be created, wave height time series to be derived and wave board drive signal files to be computed and loaded into controllers for wave generation.

Some of the capabilities of the wave generation software include:

- regular, irregular and episodic wave generation,
- control over wave grouping characteristics and wave asymmetry factors,
- support for piston, hinged-flapper and combination modes of wave board articulation,
- support for elevated wave generators,
- dynamic calibration of wave generators to improve wave generation and
- spectral matching transfer functions to achieve a better match between desired and target spectra.

Target wave spectra can be specified using parametric models or by importing prototype wave spectra. Parametric models that are supported include: Pierson-Moskowitz, JONSWAP, Bretschneider, Ochi Double-Peak, Scott, TMA Shallow Water, Newmann, Mitsuyasu -Bretschneider (1971), and Mitsuyasu (1972). Wave trains can be synthesized from target wave spectra using the Fast Fourier Transform random phase, random Fourier Coefficient or random Fourier Coefficient with matched variance methods.

Users can also define their own spectra by entering the tabulated data in an ASCII file and importing that data into a GEDAP data file format. This wave spectrum file, now in GEDAP format, can be used in place of the parametric wave spectra used in the creation of irregular waves.

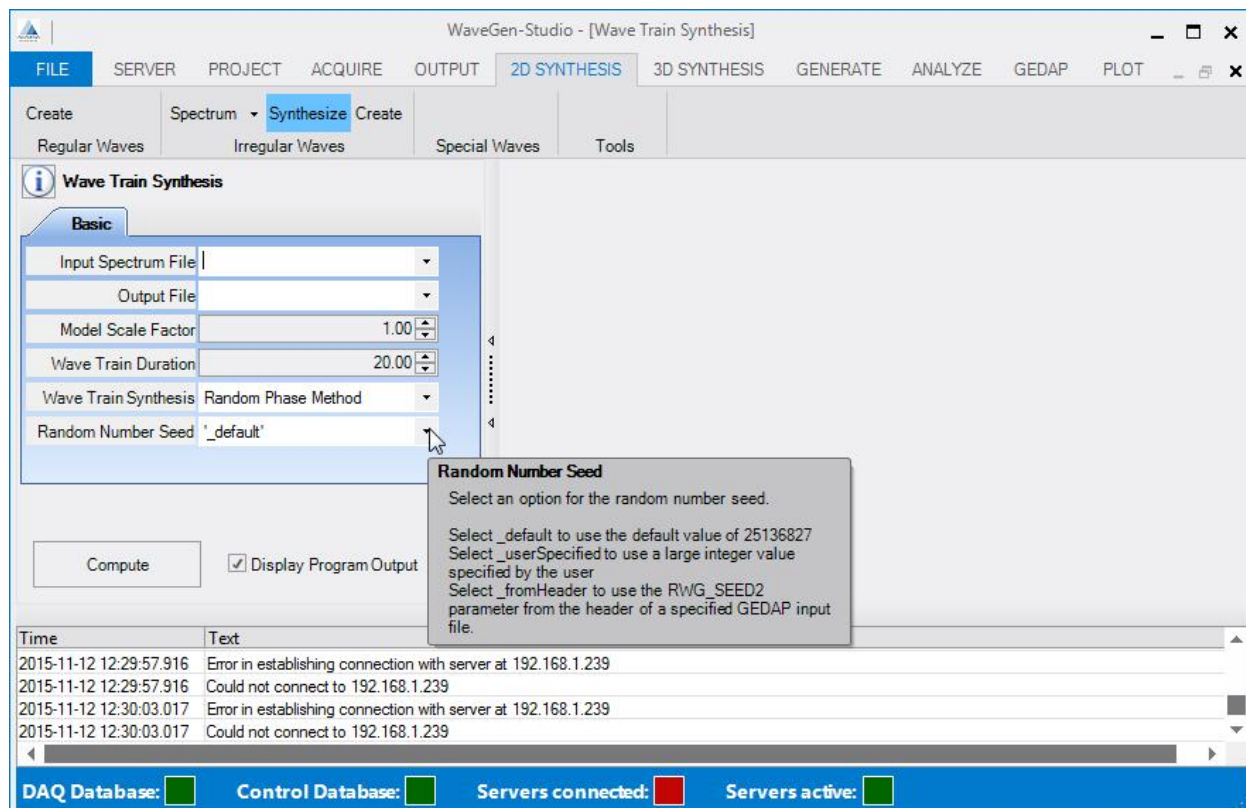


Figure 26: 2D Synthesis Main Window

Wave Generation

Wave generators will either be designed for generating 2D waves in a wave flume or generating 3D waves in a wave basin. Generally, 2D wave generators will have a single wave board/segment/paddle with a single actuator and 3D wave generators will have multiple wave boards/segments/paddles each of which is powered by a single actuator. Closed loop control of each actuator that drives a wave board is provided by a control server. Each control server provides closed loop control of typically from 1 to 32 actuators.

For 2D flume wave generators, there will typically be one control server that controls a single actuator. For 3D basin wave generators, there will be multiple control servers each of which controls multiple actuators or segments. The limit of the number of CTRL servers is governed by your license. Each time a CTRL server is added, it is queried to determine the number of actuators that it supports. For a 2D wave generator, this information is not used. For a 3D wave generator, this information is used to put together a mapping from the system segment number to a control server and segment number on that server as explained below.

Segment Numbering Explained

An example will show how the system segment number is mapped to a particular segment on a particular control server. This example system has three user named CTRL servers with their attached segments as follows; Red has 4 segments; Blue has 12 segments and Yellow has 32 segments. The servers have been added (using SERVER, Add Server button) in the above order. The system segment number is assigned as follows:

Server Name	Segments on Server	Server Name/Segment Combination	Assigned System Segment #
Red	1 - 4	Red/1 - Red/4	1 - 4
Blue	1 - 12	Blue/1 - Blue/12	5 - 16
Yellow	1 - 32	Yellow/1 - Yellow/32	17 - 48

If a control server is deleted, the segment mapping is redefined as if the control server were never added in the first place. I.e. in the example above if server Blue is deleted, what was server Yellow will take its place and the system segment numbers are remapped as shown below. Deleting and re-adding servers gives the user an ability to re-map the relationship between server/segment combinations and the system segment number.

Server #	Segments on Server#	Server Name/Segment Combination	Assigned System Segment #
Red	1 - 4	Red/1 - Red/4	1 - 4
Yellow	1 - 32	Yellow/1 - Yellow/32	5 - 36

A capture of the segment window showing the mapping between the assigned System Segment numbers (left hand column) and the control server name/Segment number combination (right hand column) is shown in Figure 28.

The Generate tab is only present on a suitably licensed WaveGen-Studio in which a CTRL database has been created and includes the activities Control and Management. Control is further broken down into the options: Models, Tuning and Limits; Management is further broken down into the options: Generate, Segments, Calibrate and Tools. Of the options under the Control tab - Selecting the Model and Applying Tuning are typically installation dependent and should only be modified by experienced personnel. These options are explained under Commissioning the Control System in the Advanced Topics section on page 47.

WGS Power-On & Power-Off states

The use and meaning of the terms Power-On and Power-Off and the corresponding states of the Wave generating drive system and the Wave Controller and WaveGen-Studio) in this manual are as follows:

Power Off State

State in which the controller power to move the wave boards (hydraulic or electric) is OFF or is about to be shut OFF. Any Power-Off offset to the wave boards (see on page 43) has been commanded before the controller power was removed. Motors are not energised and pumps are not started. Wave generation typically starts from this state.

Power On State

State in which WGS recognises that the drive system has full power applied and the drive controller has centered the wave boards and applied any Power-On offset.

Starting a Wave Generation Project

This section will describe sequentially the steps in the creation of a new Wave Generation project. The sequence also provides a quick access guide to individual actions in the generation process (e.g. another generation run) with pointers to the relevant pages describing the action and the steps required to complete it.

1. Use the existing CTRL database - see below
2. Define the limits and responses - see page 42
3. Customize segment behaviour if required - see page 43
4. Reach the Power off state - see page 45
5. Turn on drive system power - see page 45
6. Click the Power-Off button - see page 45
7. Select the Drive Signals - see page 45
8. Generation started (Ramp up) - see page 46
9. Generation stopped (ramp down, stop) - see page 46
10. Power Off - see page 46
11. Control disable - see page 46

Use the existing CTRL database

The CTRL database contains a tuned model of your system which should NOT be changed except by qualified experienced staff. It is not necessary to create a new database before commencing a new generation project.

Setting Limits and Responses

Limits on the position and velocity signals of the wave generator actuators or wave boards and the system response when they are exceeded are set under GENERATE → Control → Limits option. The units of displacement are wave generator and wave generator model dependent. Typically these units are in meters (m) and represent either the position of the drive or the position of the wave board.

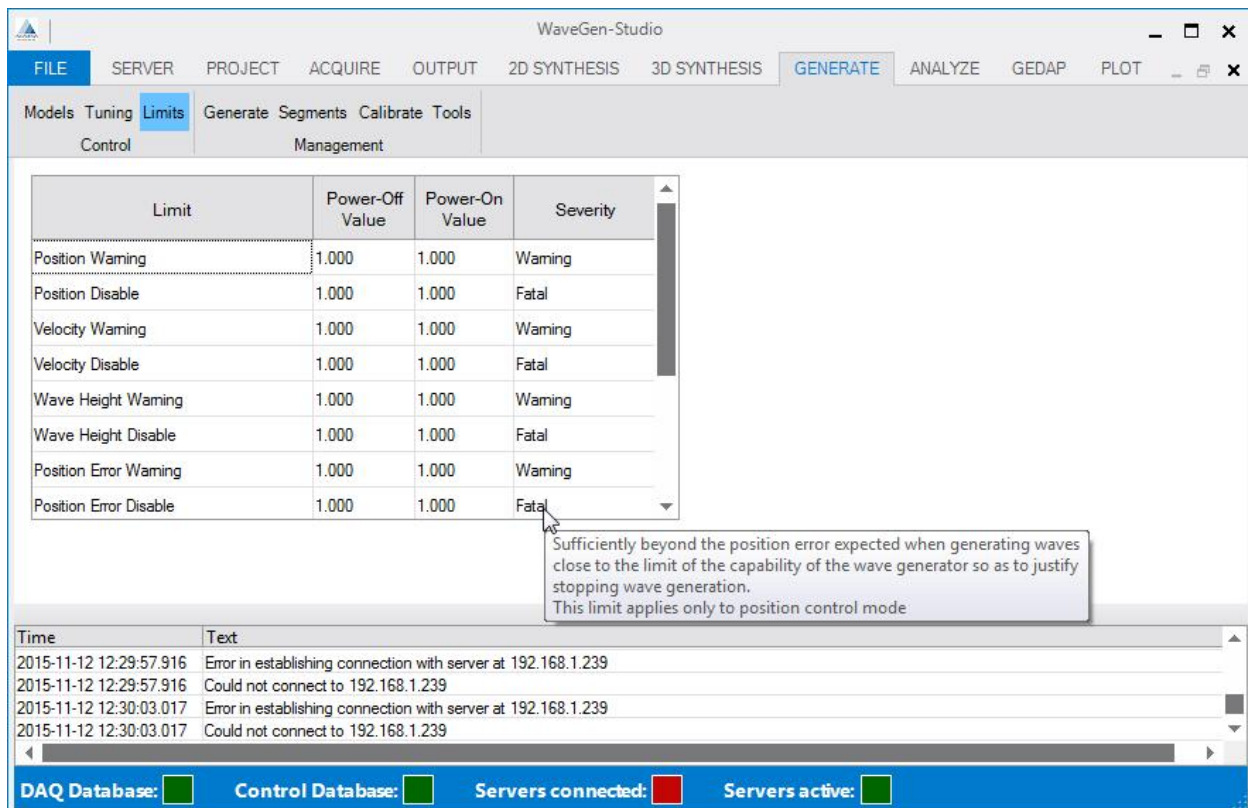


Figure 27: Limits Window with Explanation

Other units, such as lever arm angle in degrees, are possible but less common. There are two sets of limits for each parameter - one for power off and one for power on. Power-off limits are more relaxed so that the control system can move the segments when they are beyond the normal working limits. Typically this may be when the system is first started and the boards are in arbitrary positions (possibly beyond their normal working range). Power-on limits are always less than the power off limits. When a limit is exceeded an alarm is generated and a user selectable action is taken:

- **Ignore** - take no action.
- **Warning** - the control system issues a warning message but takes no further action.
- **Enforce Limit** - the control system takes action to remain within the Limit.
- **Disable AWA** - active wave absorption is disabled but wave generation continues.
- **Disable Segment** - set the control signal for the segment to 0 and continue as if the segment were disabled
- **Power Off** - change the control server to the power-off state. This involves stopping wave generation and reducing the gains used by the control server; and changing limits to power-off values. The interlock loop remains closed so that external drive power is unaffected.
- **Fatal** - Open the interlock loop (same as pressing emergency switch).

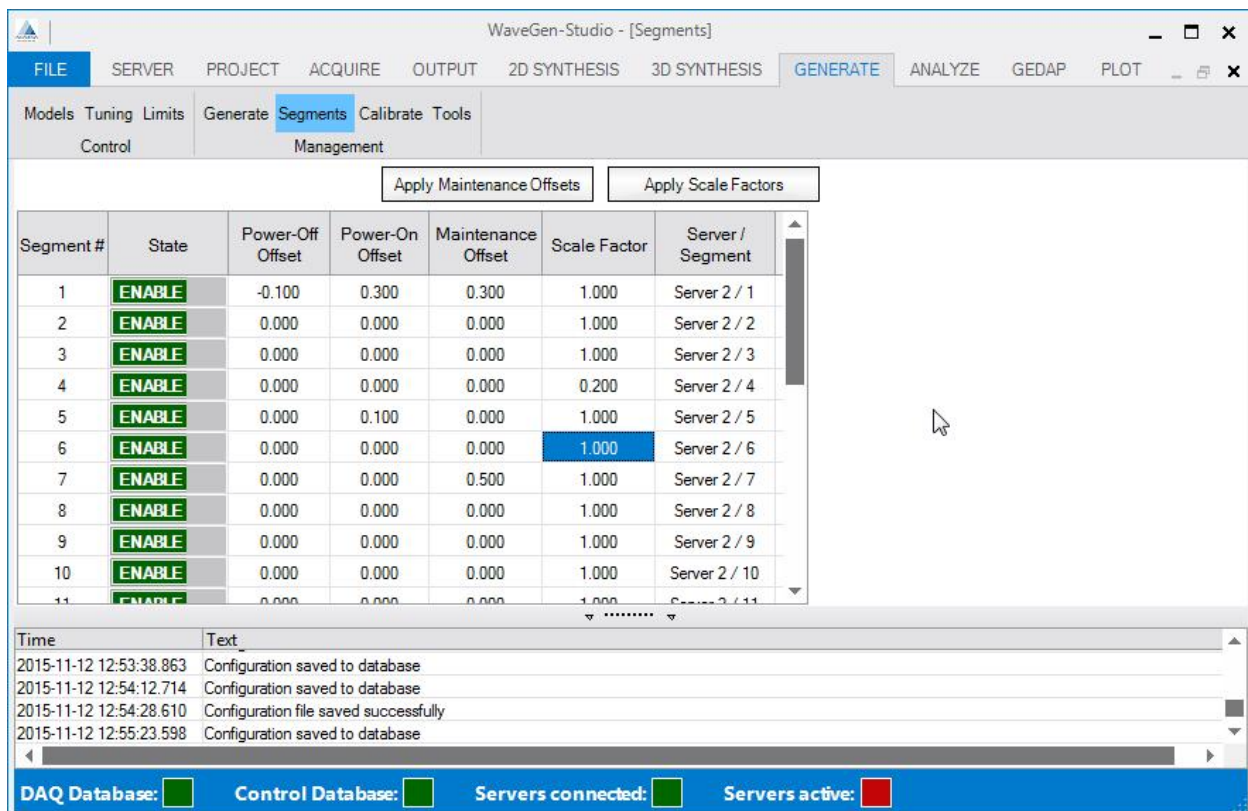
The tool tip shown on the Limit display in Figure 27 expands the meaning of the limit type and shows any restrictions that are applicable to this limit.

Managing the Segments

Segments are managed through the GENERATE → Management → Segments option. All segments identified in the system are shown, tabulated one per row, grouped by server and sorted by system segment number. Above this table, in configurations without active wave absorption, are two buttons:

- **Apply Maintenance Offsets** - applies the user entered maintenance offsets.

- **Apply Scale Factors** - applies the user entered Scale values.



Segment #	State	Power-Off Offset	Power-On Offset	Maintenance Offset	Scale Factor	Server / Segment
1	ENABLE	-0.100	0.300	0.300	1.000	Server 2 / 1
2	ENABLE	0.000	0.000	0.000	1.000	Server 2 / 2
3	ENABLE	0.000	0.000	0.000	1.000	Server 2 / 3
4	ENABLE	0.000	0.000	0.000	0.200	Server 2 / 4
5	ENABLE	0.000	0.100	0.000	1.000	Server 2 / 5
6	ENABLE	0.000	0.000	0.000	1.000	Server 2 / 6
7	ENABLE	0.000	0.000	0.500	1.000	Server 2 / 7
8	ENABLE	0.000	0.000	0.000	1.000	Server 2 / 8
9	ENABLE	0.000	0.000	0.000	1.000	Server 2 / 9
10	ENABLE	0.000	0.000	0.000	1.000	Server 2 / 10
11	ENABLE	0.000	0.000	0.000	1.000	Server 2 / 11

Figure 28: Managing Segments

The table contains a row for each of the segments that a user has defined in their system. The columns in the table are:

- **Segment #** - the system segment number (from 1 to the number of segments defined in the system). This column is not editable.
- **State** - the segment enabled state. Uses a slider similar to that used in the Channels table that is red with the text DISABLE if the segment is disabled and Green with the text ENABLE if the segment is enabled. All segments are by default enabled when the server is added.
- **Power-Off offset** - this is the offset that is to be added to the commanded wave board position when the power to the wave generator is being turned off. The segments move to these positions as part of the power-off procedure. It is a floating-point number in the range of + or - the value provided by the user for the Position Warning Limit (GENERATE →Control →Limits). The value defaults to 0.0 when the server is added.
- **Power-On offset** - this is the offset that is to be added to the commanded wave board position when the power to the wave generator is being turned on. The segments will be moved to these positions as part of the power-on procedure. It is a floating-point number in the range of + or - the value provided by the user for the Position Warning Limit (GENERATE →Control →Limits). The value defaults to 0.0 when the server is added.
- **Absorption Coefficient** - this is a floating point number between 0 and 1 that specifies the absorption coefficient to be applied to the segment. This value allows the user to scale the percentage of incoming waves that will be absorbed by the control system for the individual segment. The column is editable by a user; and is only visible if the user is licensed for AWA_3D. The value defaults to 1.0 when the server is added. (1 = 100% absorption)
- **Maintenance Offset** - this offset replaces any other commended offset and moves the actuators to a position where physical access for maintenance is available when the Apply Maintenance Offset button is

pressed. It is a floating-point value that can be set anywhere between 0 and 1.25 x the Position Disable Limit, with a default value of 0.

- **Scale** - this value is used to adjust the amplitude of generated waves for individual segments. It is a floating-point value that is ≥ 0.0 and ≤ 1.0 with a default value of 1.0. **Note:** if not applied manually with the Apply Scale button, the scale values are stored in the CTRL database and will be applied the next time the Configure button is pressed in the wave generation sequence.
- **Server Name/Segment** - this column shows the combination of user chosen Server Name and the number of the segment on that server. This is not the same as the system segment number. The relationship between these is explained in Segment Numbering Explained on page 41.

Data may be entered and saved in any segment state, but only segments with their state set to enable will respond to the settings when generating a wave.

Reaching the Power-Off State

To start the wave generation procedure the following initial conditions must be met. Completion of these conditions places the Control system in the Power-Off state.

1. All CTRL server(s) must be powered up and running; be connected to WGS and be Active.
2. Changes to Limits, if required, have been completed.
3. The stored system model, tuning and limits must be applied through pressing the (GENERATE →Management →Generate) Configure button.
4. Control must be enabled (green) by pressing the (GENERATE →Management →Generate) Control Disabled button. **Note:** if one or more of the CTRL servers does not have control enabled, this button will display red.

Applying Drive system Power

At this point the user can apply (or reapply) power to the drive system. No movement will occur.

The Power-On Button

After control has been enabled and power has been applied to the drive system, press the Power-Off button to inform WGS that the drive system has full power applied. WGS takes the wave boards, moves them to their Power-On Offset to reach the Power-On state. The progress of this ramp up is shown in the progress bar. The Power-On button colours show the power-on condition as follows:

- Grey if control has not been enabled.
- Green and displays the text "Power ON" if all CTRL servers are in the Power On state.
- Red and shows "Power OFF" if all CTRL servers are in the Power Off state.
- Yellow and shows "Power Unknown" if some CTRL servers are in the Power On state and others are in the Power Off state.
- If the button is green or yellow and it is pressed, a Power Off command is sent to all of the CTRL servers. The button turns red when all of the commands have been sent.
- If the button is red and it is pressed, a Power On command is sent to all of the CTRL servers. The button turns green when all the commands have been sent and acknowledgements received.

Select the Drive Signals

Pressing the Load Drive Signals button opens a window allowing the user to navigate to and select the Drive Signal file to apply. Alternatively, clicking the Sinusoidal Signals button launches the small pop up shown in Figure 29 allowing the sinusoidal parameters to be specified.

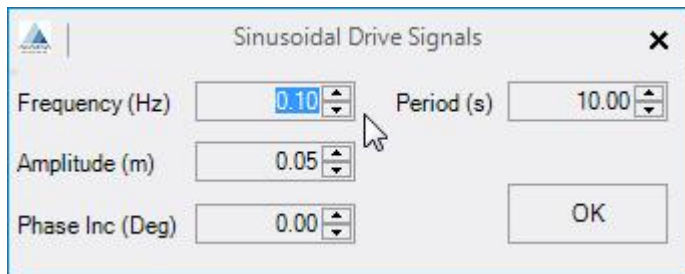


Figure 29: Specify Sinusoidal Drive Signals

Start Generation

Pressing the Generation Stopped button causes WGS to begin tracking the drive signal. The scale factor is ramped up from 0 to the value Applied in the Wave Generation Scale Factor box. Generation continues until either the drive signal run time of the file expires, or the Generation Started button is pressed. The Wave Generation Scale Factor can be adjusted and applied at any time during this sequence.

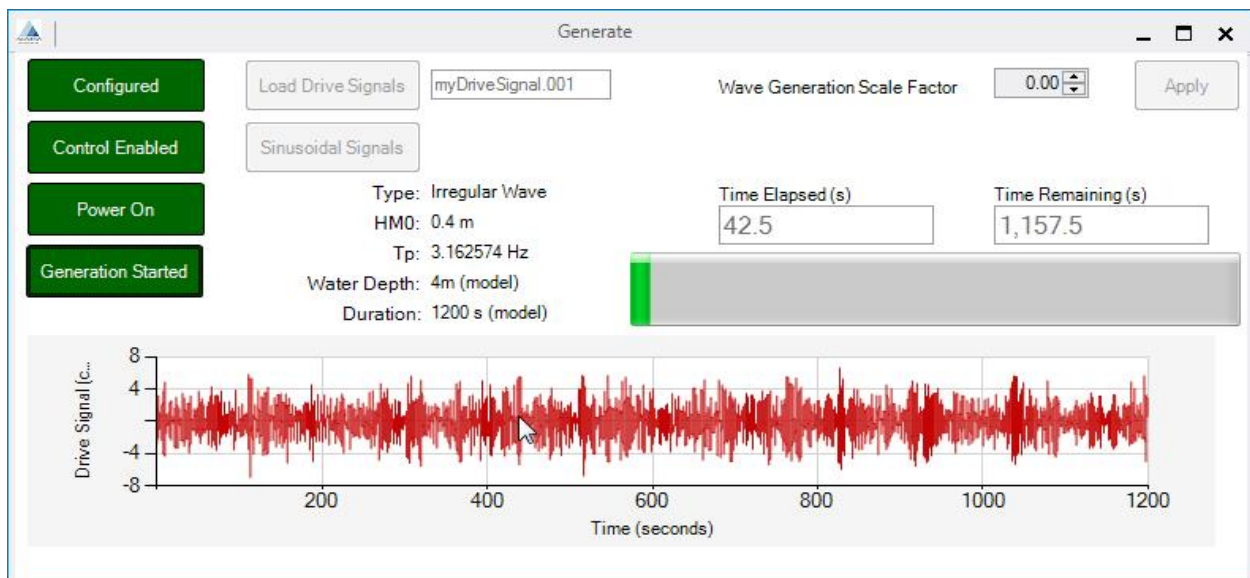


Figure 30: Generation in Progress

Stop Generation

Pressing the Generation Started button causes the scale applied to the controller outputs to be reduced to zero over the next 10 seconds.

Power-Off

When wave generation has stopped, press the Power-On button to relax the limits and loop gains applied during generation. The wave boards are commanded to remain at their current position, allowing the operator to turn off the drive system power.

Apply Control Disable

Control can be disabled (green) if desired by pressing the (GENERATE → Management → Generate) Control Enable button to apply the control disable. Normally, there is no need to disable control when ending a wave generation session.

Advanced Topics

This section contains instruction enabling the user to create or modify the wave generator control model and to tune the controller for the desired performance.

WARNING: Incorrect or out-of-bounds settings made here can introduce unsafe and potentially dangerous conditions to the Wave Generation process. Changes must be carried out by qualified control systems staff only.

Commissioning the Control System

Commissioning the Control system normally consists of five steps and is performed only when a significant change is made to the Wave generator requiring a change to the model, tuning or limits saved in WaveGen-Studio. These steps are:

1. Create a CTRL database see below
2. Add at least one control server see page 20
3. Select and refine the Model see below
4. Tune the controller see page 48
5. Set Limits see page 42

Creating a CTRL database

During commissioning of your system, a control system database will have been created and populated with a model of your wave generation system and the tuning parameters and limits to promote safe operation. You are recommended to make a backup copy in case of need. This master CTRL database is stored in "C:\Program Files (x86)\Akamina\WaveGen-Studio\". If you select File → New Control Database you will replace the existing database with a new empty control database and **all system Model and Tuning data will be lost.**

Selecting the Model

The GENERATE → Control → Model interface shown in Figure 31 is used to define the details of the drive system that are required to derive a mathematical model including the drive, any amplification between the drive and the wave board and the mass and damping of the moving parts of the wave board and water system. After logging in, the user accesses a detailed interface allowing them to enter basic or advanced information.

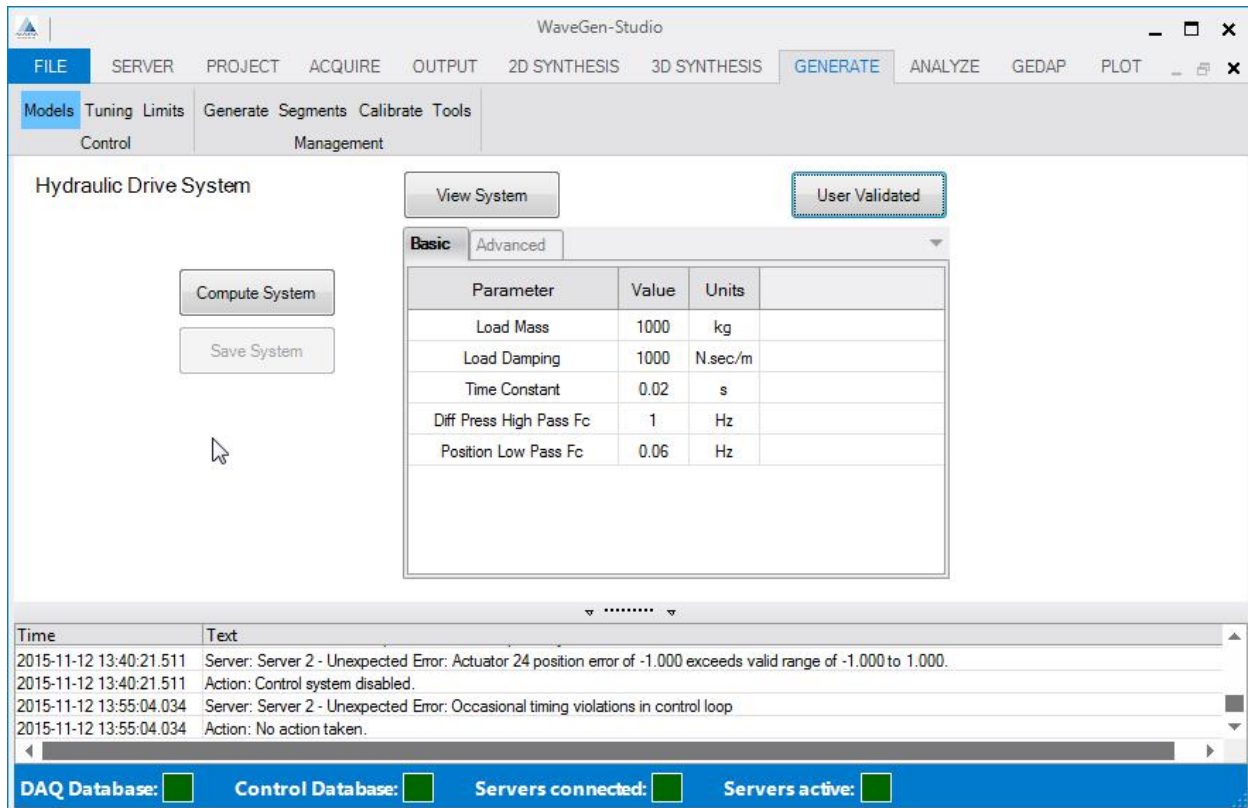


Figure 31: Create the Model

The window contains the following elements:

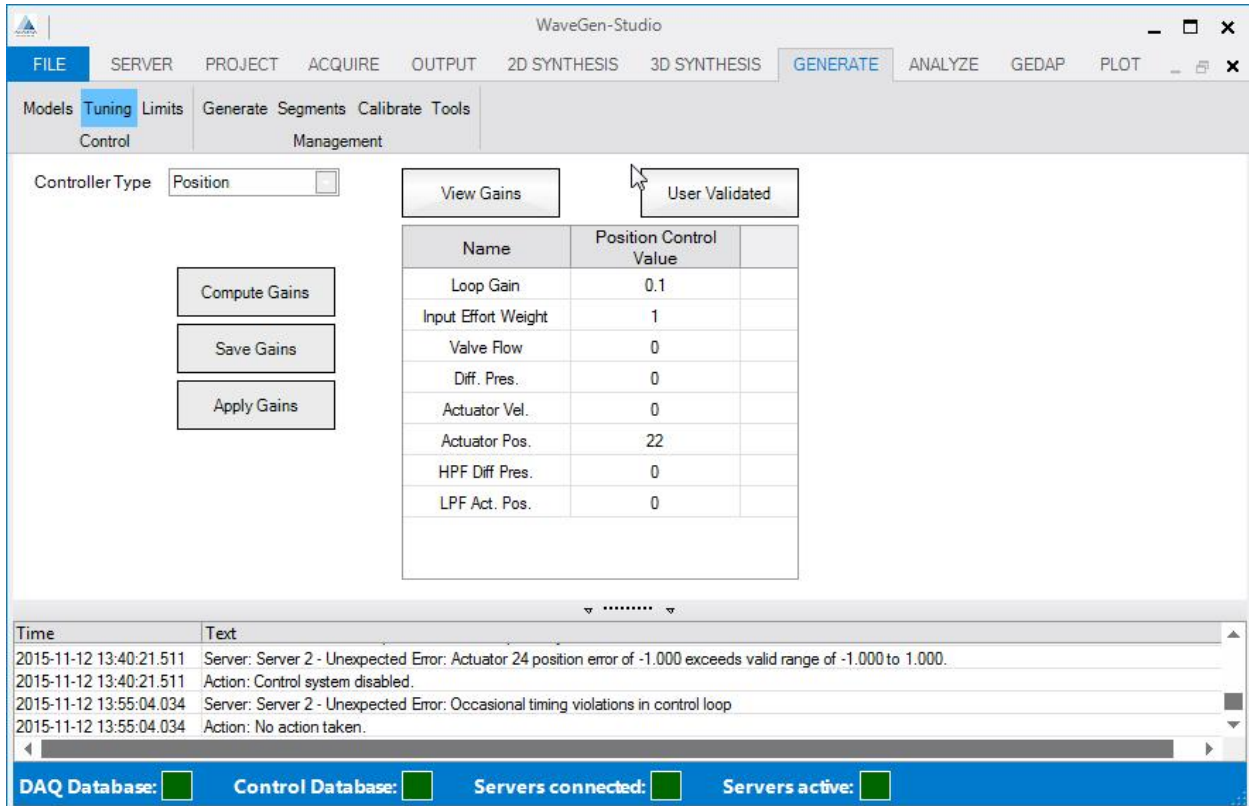
- **View System** - Show the Control System matrices in a separate window. Shows either the information for the system model stored in the database or the new model computed after the Compute System button is pressed.
- **Validate User** - this button calls up a user ID and password window and compares the input credentials with the stored values.
- **Compute System** - a button that causes a new system model to be computed.
- **Save System** - a button that saves the system model to the database.
- **Basic/Advanced tab** - a drop-down box that allows the user to select which of the basic or advanced parameters are to be visible. The default is basic.

Applying Tuning

The GENERATE → Control → Tuning interface shown in Figure 32

Setting Limits

How to set limits was explained on page 42. Figure 32: Tuning the Model



WaveGen-Studio

FILE SERVER PROJECT ACQUIRE OUTPUT 2D SYNTHESIS 3D SYNTHESIS GENERATE ANALYZE GEDAP PLOT

Models **Tuning** Limits Generate Segments Calibrate Tools
Control Management

Controller Type: Position ☐

View Gains User Validated

Name	Position Control Value	
Loop Gain	0.1	
Input Effort Weight	1	
Valve Flow	0	
Diff. Pres.	0	
Actuator Vel.	0	
Actuator Pos.	22	
HPF Diff Pres.	0	
LPF Act. Pos.	0	

Compute Gains Save Gains Apply Gains

Time	Text
2015-11-12 13:40:21.511	Server: Server 2 - Unexpected Error: Actuator 24 position error of -1.000 exceeds valid range of -1.000 to 1.000.
2015-11-12 13:40:21.511	Action: Control system disabled.
2015-11-12 13:55:04.034	Server: Server 2 - Unexpected Error: Occasional timing violations in control loop
2015-11-12 13:55:04.034	Action: No action taken.

DAQ Database: ☐ Control Database: ☐ Servers connected: ☐ Servers active: ☐

Figure 32: Tuning the Model

FAQs

What is Metadata?

Metadata is project values defined by the user. It includes: general information about the project, set up and configuration data and calibration data.

Why hasn't my Project Data appeared in the database?

When the new database is created, there is no connection to a server. WaveGen-Studio cannot transfer metadata related to a server to the database until a connection has been established. As a result of this dependency, if the user, immediately after creating the DAQ database enters data under the PROJECT tab, the data will not be immediately transferred to the database and will wait for a server to be added and a connection to be established.

How do I find the WGS version number?

The About interface is available for the user to check the information associated with the current installation of WaveGen-Studio. Information such as the version of WaveGen-Studio and contact information for Akamina Technologies can be obtained by selecting the About option in the FILE tab pull-down menu.

In which directory is WaveGen-Studio installed?

WaveGen-Studio installs in C:\Program Files (x86)\Akamina\WaveGen-Studio\.

Where are the database and license files stored?

The database files are stored in C:\ProgramData\Akamina\WaveGen-Studio. The license file is stored in C:\Users\yourusername\My Documents\Akamina.

Where are the GEDAP programs stored?

GEDAP is installed in C:\Program files (x86)\Akamina\GEDAP.

What is the Format of an exported file?

Files can be exported (FILE → Export) in either GEDAP data file format or in Excel csv format. For csv format files, the file created by the Export includes both the metadata from the acquired data session as well as the data acquired from the session. A sample of a file exported is shown below. The metadata is contained within META Start and META End tags; the Acquisition Data immediately follows the META End tag.

The tags and contents of the file are presented in the order listed below:

- **META Start** tag, Project data and Configuration data.
- **DEVICES Start** tag, followed by information about each of the devices and channels from which data were acquired.
- **DEVICES End** tag.
- **CHANNELS Start** tag: followed by information about each of the channels from which data was acquired. The key information in the block includes: device and channel number, sensor information and the calibration slope and offset.

- CHANNELS End tag.
- META End tag.
- **Acquisition Data:** a table of collected data based on time and channel(s). There is a column for time and a corresponding column for every channel for which data was acquired. The data are in the units in which the channels acquired them; the calibration curve provides the relationship between acquired data units and physical reference units defined during calibration.

META Start											
Client	Internal										
Contact Person	Peter										
Project Title	ADQ-1000 Documentation										
Test Facility	Very large basin										
Model Description	1:1 scale model										
Model Scale	1										
Horizontal Scale	1										
Vertical Scale	1										
Time Scale	1										
TSampleCal_s	10										
ProjectCreated	17-12-13 12:19										
ServerVersion	387										
StartTime	24:06.7										
StopTime	24:12.4										
Frequency	50										
DEVICES Start											
UserDeviceNumber	DeviceType	DataForm	DataRef	DataRange	DataDescr	DataUnits					
3	Analog Input	Float32	Differential	+/-10V							
5	Serial I/F	Float32	Other	unknown							
DEVICES End											
CHANNELS Start											
UserDeviceNumber	UserChannelNumber	DeviceCha	SensorName	SensorMod	SensorSeri	DataDescr	DataUnits	DateCal	NameCal	Slope	Offset
3	1	3_1	Analog Ch	alpha	3131	Voltage	mV	01-01-01 0:00		1	0
5	1	5_1	CAN Bus 2	AWP-300	79	Reading	Units	01-01-01 0:00		1	0
CHANNELS End											
META End											
SecondsSinceStart	3_1	5_1									
0	148.9258	0									
0.02	148.6206	0									
0.04	148.9258	0									
0.06	148.9258	0									
0.08	148.9258	0									
0.1	148.9258	0									

Contact Information

Contact info@Akamina.com for technical questions about the installation of the WaveGen-Studio.

Akamina Web Site

You may visit <http://www.akamina.com> for more information on products and solutions available from Akamina.

Reference

How do I Change the IP address of my WaveGen-Studio?

Before installing on your LAN

Your WaveGen-Studio server is shipped with a factory default IP address of 192.168.1.30. This can only be changed from within the WGS application. To change this address without installing the WGS on your LAN, connect the PC running WGS directly to the Server rear panel Ethernet port using a cross connected Ethernet cable. Set the IP address of this interface on the WGS PC to the same subnet and start WGS. Open the ACQUIRE → Setup → Server option and click the Add Server button or select the server whose IP address you wish to change. In the IP Address field, double click the portion of the address to be changed and enter the new address. A warning message will ask you to wait for 90 seconds and then click the connect button to connect to the server at the new IP address.

After installation on your LAN

To change the IP address of your server, start WaveGen-Studio and open the ACQUIRE → Setup → Server option. Click the Add Server button or select the server whose IP address you wish to change. In the IP Address field, double click the portion of the address to be changed and enter the new address. A warning message will ask you to wait for 90 seconds and then click the Disconnected field to connect to the server at the new IP address.

Note: in either case, if you move the Server IP address to a different subnet (e.g. 192.168.2.100) you will need to move the WGS PC to the same subnet before attempting a re-connection.

Using AWP-300 Sensors

The following description assumes that the AWP-300 wave height gauges have been prepared as described in the *AWP-300-3 User's Guide*, available on the Akamina website. The minimum steps required to prepare the sensors for use are:

1. Connect the AWP-300s in one or two daisy chains and connect each daisy chain to one of the CAN Bus connectors on the rear panel of the data acquisition server.
2. Discover the sensors (see page 54).
3. Assign the sensor to channels (see page 55).
4. Immerse the wave probe heads to the maximum immersion depth.
5. Configure the sensors (see page 68).

AWP-300 digital wave height gauges are not directly connected to an input channel. Anywhere from 0 to 30 gauges can be connected to the same CAN Bus and are associated by WaveGen-Studio and the server to a specific channel. This management is done under the ACQUIRE → Setup → AWP-300 option.

The AWP-300 interface is shown in Figure 33 **Error! Reference source not found.** It is only possible to use this interface if the server is not actively sampling (i.e. the Active Status in the SERVER interface is red Not Active). Turning off the sampling messaging between the server and the AWP-300 gauges allows management messaging to use the CAN Bus.

Choosing the Server

Use the Selected Server pull down menu option to select which server to work on.

Show Only Assigned Channels

When the Setup → AWP-300 interface is first loaded, only those channels that have been assigned serial numbers are displayed. Unchecking the Show Only Assigned Channels tick-box will result in all serial-type channels being displayed immediately - regardless of whether any gauges have been assigned to any channels (Figure 33).

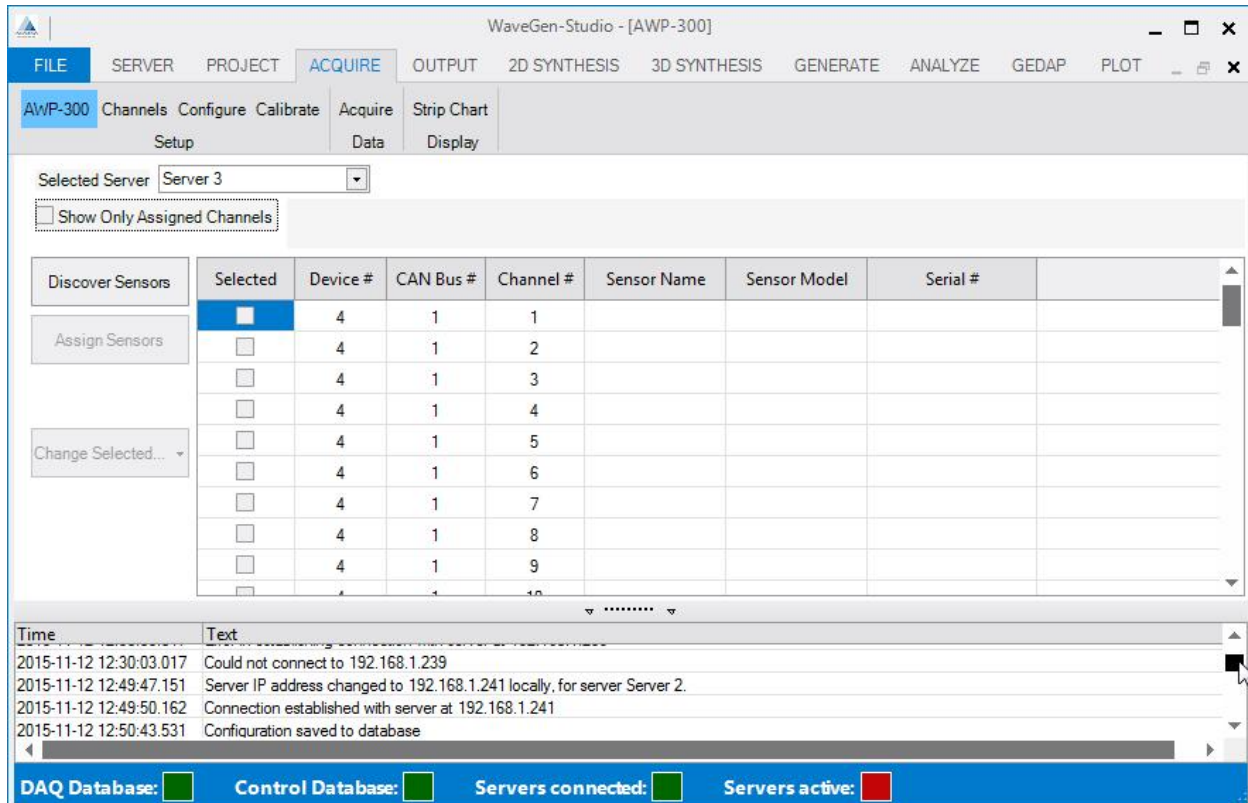


Figure 33: Setup AWP-300 Option

Discovering Sensors

The Discover Sensors button is used to find sensors that are connected to the CAN Bus. The Discover Sensors button is only enabled if the client is connected to the server and the server is not in the Active state. If this is not true the button is disabled and appears on the screen in a faded colour. When enabled, pressing on the Discover Sensors button causes the server to identify all gauges that are connected to the CAN Bus connectors on the rear panel of the selected server. Once the AWP-300 gauges have been discovered, a Discover Sensors pop-up window appears(see Figure 34). This example shows that AWP-300s with serial numbers 105 and 106 have been discovered attached to CAN Bus 1; no sensors have been discovered on CAN Bus 2.

If a sensor has just been discovered in this process its Status will be 'New'. It will have the status 'Changed' if the sensor has been moved to a different CAN Bus since the last assignment, 'Unchanged' if it is still connected to the same CAN Bus as it was on the last assignment and 'Removed' if it is no longer connected to any CAN Bus.

If this information is acceptable, the user should click on OK to accept the discovery and proceed with assignment. If not all of the sensors have been discovered, click on Cancel, check the physical state of connections to the missing sensors, make any necessary adjustments and attempt discovery again.

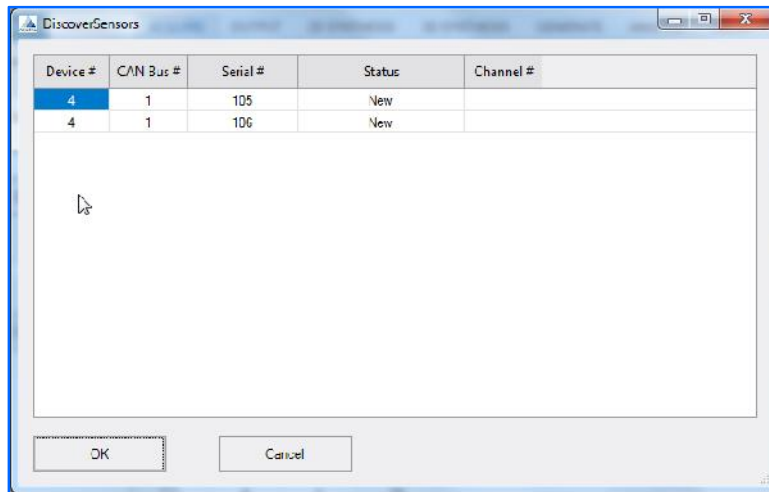


Figure 34: Discover Sensors Pop-up Window

Clicking on OK closes the Discover Sensors pop-window and the AWP-300 window to re-open (Figure 35) with:

- The Show Only Assigned Channels box checked.
- A message displayed above the Assignment Table indicating the number of sensors that need to be assigned to a channel. (in this example showing: '2 Sensors needs to be assigned').
- A list of channels with sensors attached. Each of these channels needs to have serial #'s of discovered sensors assigned to them.

The user should assign each of the discovered sensors (with a unique Serial #) to a channel.

Note: All available sensors must be assigned to complete this phase. If the user quits without finishing, the assignment process will need to be restarted from the beginning.

Assigning Sensors to Channels

To assign sensors to channels:

1. Identify a device and channel in the Assignment Table that you want to assign a sensor to.
2. Move to the Serial # field in the corresponding row and double click. A drop-down assignment list (see Figure 35) will appear if there are sensors available to assign to that Device/Can Bus/Channel #. Select a sensor, by its serial number to associate it to that channel. **Note:** that once a serial number has been associated using this procedure it will no longer show up on the drop-down assignment list and the message at the top will be updated to reflect the number of sensors that still need to be assigned.

Note: at this stage in the process, the sensor is considered to be reserved for assignment to the selected channel.

3. Repeat step 1 and 2 for all available sensors for both CAN Bus' until there are no more available sensors to assign.
4. Once all of the sensors have been assigned, the Assign Sensors button will be enabled. By pressing this button the DAQ database and server are updated and the assignment of the sensors is completed.

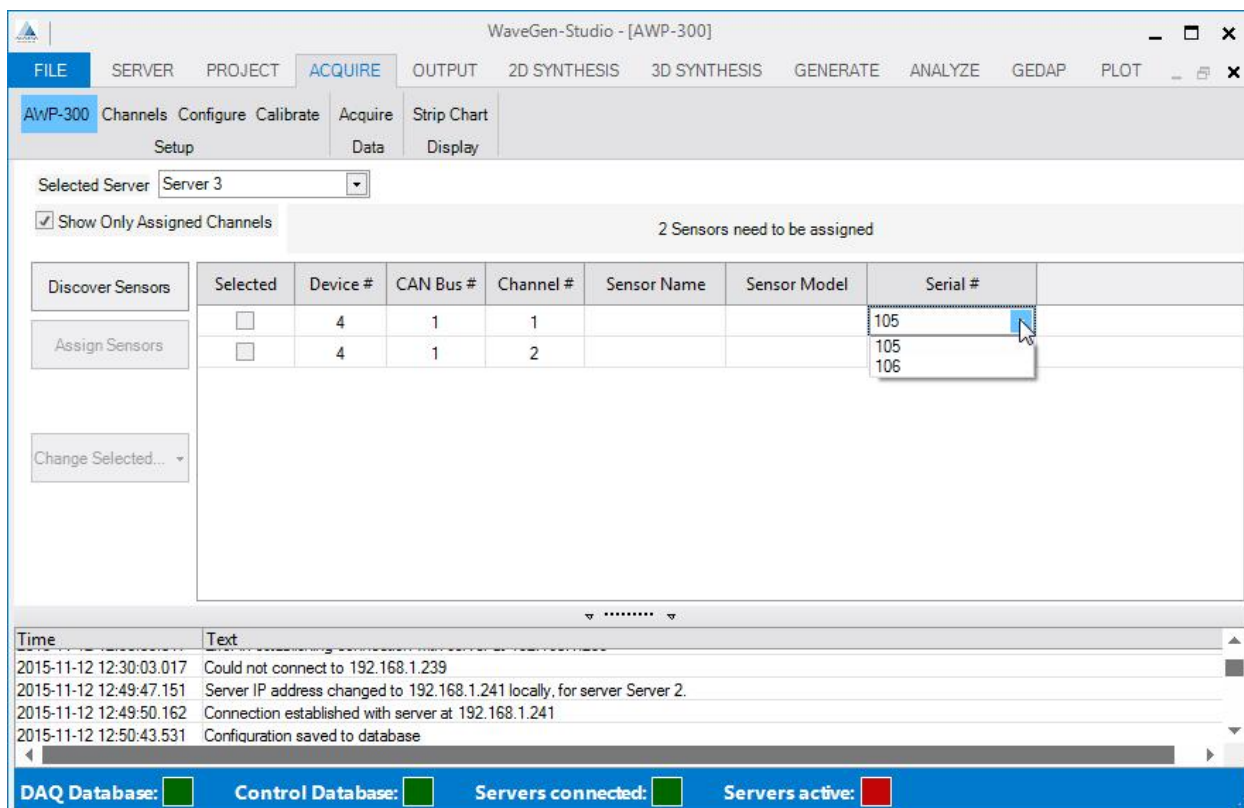


Figure 35: Assign Sensors Window

Notes about Assigning and Removing Sensors

1. Referring to the previous example (Figure 33), if we scroll down the page and attempt to assign a serial number to Device 5, Channel 1, double-clicking in the Serial # cell displays an empty drop-down list. This is the result of the discovery process not finding any sensors on Device 5, CAN Bus 1. Double-clicking in the Serial # cell for Device 4, Channel 1, however, results in a drop-down list that includes serial numbers 105 and 106.
2. Once a serial number has been temporarily assigned, it is no longer on the drop-down assignment list.
3. Double-clicking in the Serial # cell that has an assigned serial number gives the user the option to Remove Association. This removes the serial number assignment from the device/channel and makes it available to be assigned to another channel.
4. A sensor can be assigned to any channel on the CAN Bus where the sensor was discovered. However, CAN Bus messaging efficiency is improved if lower channel numbers are used.
5. Text can be entered in any Sensor Name or Sensor Model cell regardless of whether there is a sensor assigned to the device/channel or not.
6. A user cannot assign a subset of the sensors discovered - all discovered sensors must be assigned.

An example of a portion of the AWP-300 table during the assignment of serial numbers 105 and 106 to Device 4, Channels 1 and 2 respectively is shown in Figure 35. Text entries have not yet been added to Sensor Name and Sensor Model fields.

Change Selected

The Change Selected button is provided to allow the user to carry out additional actions on the selected AWP-300s. Selecting a sensor and clicking the Change Selected button results in a pull-down menu with the following options:

- **Clear Configuration** - clear the internal configuration information for the selected AWP-300s.
- **Configure** - cause the selected AWP-300s to complete an internal configuration. This process can take up to 60 seconds to complete for each sensor.
- **Override Minimum** - override the minimum immersion point for the selected AWP-300s.
- **Set Immersion Depth** - set the current immersion depth for the selected AWP-300s as a percent of the maximum depth. A pop-up requesting the user to set the immersion depth will appear. The valid range is from 10.00 to 100.00 (inclusive).
- **Set Coax Length** - set the length of the co-axial cable between the wave height gauge probe head and the wave height gauge electronics for the selected AWP-300s. This command accepts a single value.

Note: Many of the actions above invalidate the AWP-300 calibration information. If the action invalidates the calibration and a selected AWP-300 has been calibrated, the calibration coefficients will be deleted. A warning is issued before any calibrations are erased.

How to Install my WGS Software

The WaveGen-Studio software is suitable for use with WindowsTM 7 and WindowsTM 8. To complete the installation, MicrosoftTM .NET Framework 4 will also be required. In addition to WaveGen-Studio, the GEDAP software package will need to be installed for full data analysis functionality. The installers for both WaveGen-Studio and GEDAP are included as part of the package.

WaveGen-Studio is delivered as a zip file that includes the Windows installation package. To start the installation, double-click on the zip file and then double-click on the file: WaveGen-Studio.msi. This will start the installer and present the window shown in Figure 36.

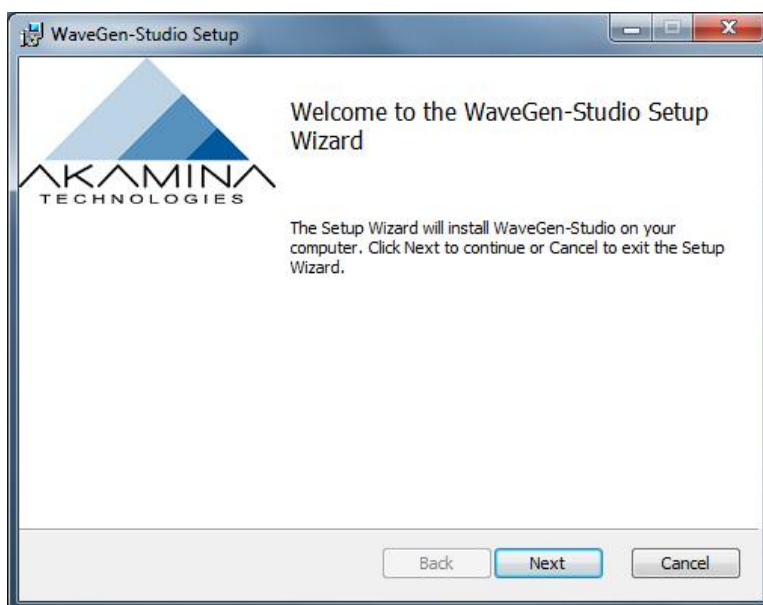


Figure 36: Initial Install Screen

Click on the Next button to proceed or Cancel to cancel the installation of WaveGen-Studio. The install process will then display the End-User License Agreement screen (see Figure 37). You may choose to print the License by selecting the Print button. After reading through the license agreement, if you wish to accept the agreement and continue with the installation, tick the check-box indicating your acceptance and then click on Next to continue.

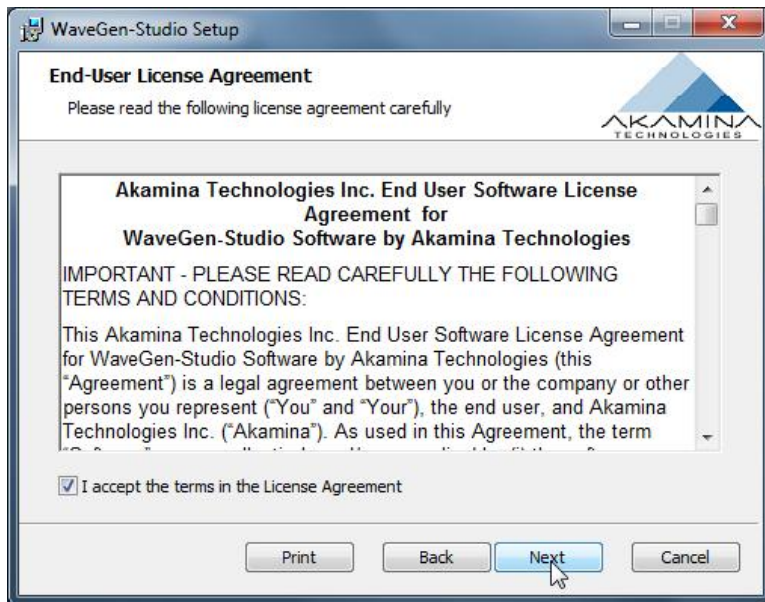


Figure 37: End User License Agreement

In the next step of the installation, select Typical for the recommended installation. This will bring up the ready to install screen Figure 39.

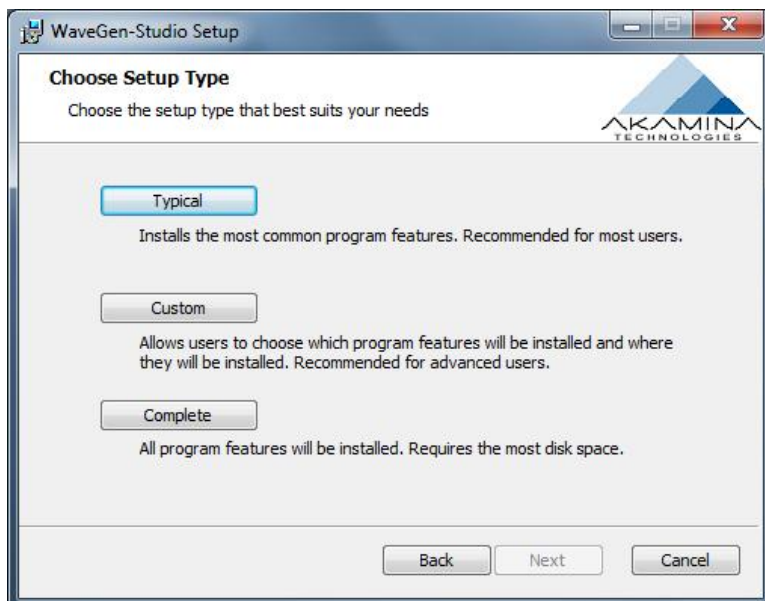


Figure 38: Choose Installation Type

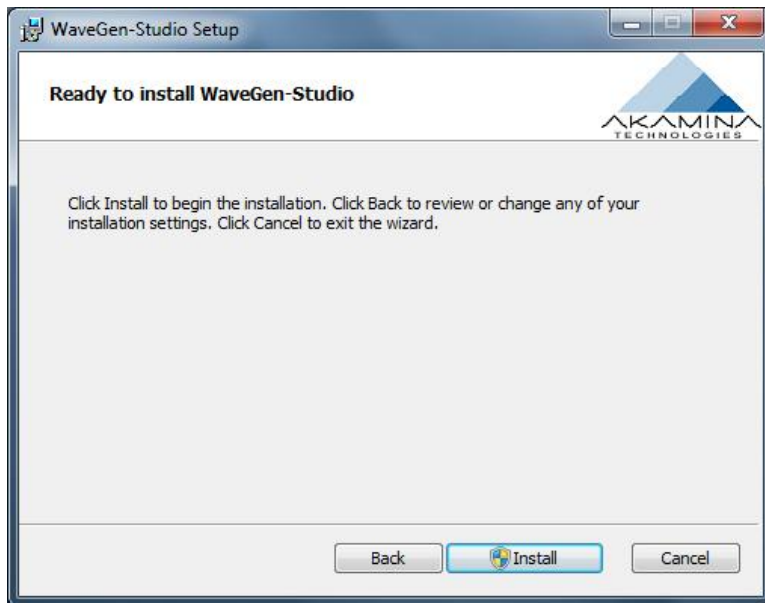


Figure 39: Ready to Install

The progress of the install is provided (Figure 40) as the installation progresses.

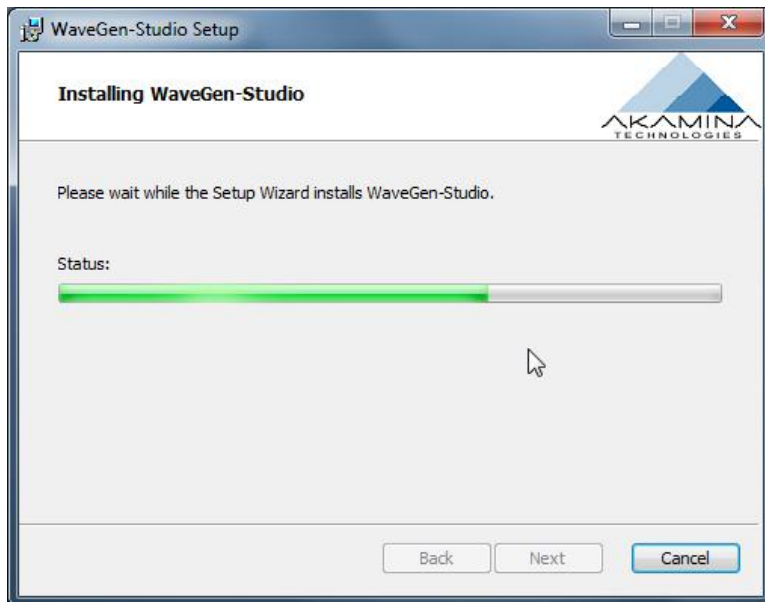


Figure 40: Installation Progress

Click Finish when the installation is complete (Figure 41).

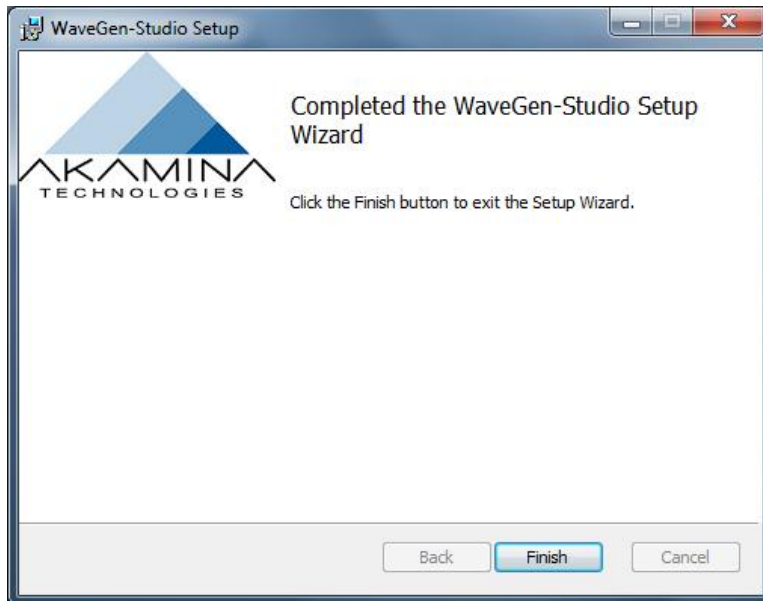


Figure 41: Installation Complete

Once the installation is complete, it is ready to use. WaveGen-Studio can be found under: Programs → Akamina → WaveGen-Studio.

Install and Test GEDAP

The GEDAP software is delivered as a zip file that includes the GEDAP Windows installation package. To start the installation, double-click on the zip file and then double-click on the file: GEDAP.msi. This will start the Windows installer and installs GEDAP in C:\Program files (x86)\Akamina\GEDAP. The installation of GEDAP installs the GEDAP software, GPLOT software and an on-line help file.

Once GEDAP has been installed and licensed using the same procedure and license key provided for WGS it can be tested to confirm that it is properly installed and configured as follows:

- 1 Open up a Command Prompt. This can be done through the Windows Start menu by entering `cmd` and pressing Enter.
- 2 Change to the directory created by the GEDAP installation that includes the test file. This can be done by entering the following into the command prompt: `cd c:\Users\Public\Documents\Gedap`
- 3 To run the test program enter the command: `gbat GEDAP_BasicAnalTest.GBAT`

The test program executes a number of GEDAP programs using a test data file supplied with the installation. After the programs are executed, a GPLOT command file is executed that results in the image shown in Figure 42 being shown on the PC. This output confirms that both GEDAP and GPLOT are working properly.

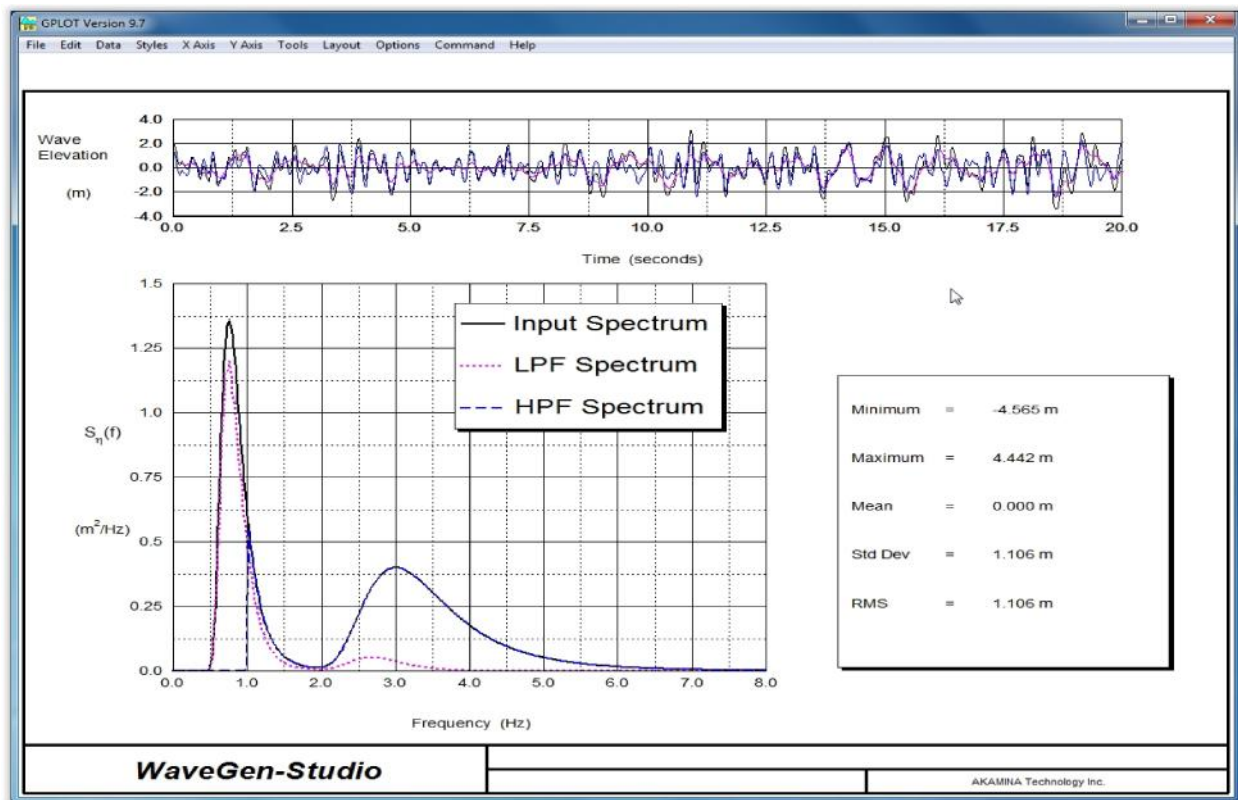


Figure 42: GPLOT Output after Executing the Test Batch File

The ASCII files GEDAP_BasicAnalTest.GBAT and GPLOT_BasicAnalTest.GPC, can be used as templates for custom batch files and plot files.

GEDAP is made up of a large number of independent programs. Any GEDAP program can be executed from a Command Prompt window by entering the name of the GEDAP program to be executed. Depending upon the user license obtained, some of these programs may not be available to the user even if the program itself is present. If

you enter the name of a program that is not licensed, a license prompt similar to that shown in Figure 43 will appear. This prompt gives the user the opportunity to upgrade the GEDAP and WaveGen-Studio license file to enable additional functionality.



Figure 43: Running an Unlicensed GEDAP Program

On-line help for GEDAP and GPLOT is available. The help can be accessed by opening a Command Prompt and entering the command: GHELP. Further guidance is provided under the section Getting Help (see page11).

Features of GEDAP

GEDAP is a general purpose software package for the analysis and management of laboratory data. GEDAP is a well-proven system that has been developed over many years to satisfy a broad range of real-world project requirements with particular emphasis on random wave generation and data analysis in hydrodynamics laboratories. It can also be used for other applications including the analysis of full-scale data. GEDAP can greatly enhance the capabilities of most existing 2D and 3D wave generators.

GEDAP Features:

- Fully upgraded to run on any Windows 7 or Windows 8 PC 32-bit or 64-bit PC.
- Fully integrated modular package using a common data file structure and a common set of support routines.

- Allows users to add their own Fortran programs by taking advantage of more than 350 subroutines available in the various libraries.
- Includes automatic data tracking tools for quality assurance systems such as ISO 9000.
- Ancillary parameters, which are automatically stored in GEDAP file headers during data acquisition and analysis, can be easily retrieved for use in spreadsheets or plot labels.
- GEDAP programs can either be run interactively or in batch mode to analyze multiple sets of input data.
- Complete on-line documentation accessed by standard Web browsers.
- Comprehensive set of programs for unidirectional (2D) and multi directional (3D) wave generation in flumes, basins and towing tanks.
- All types of wave machines supported: piston, flapper, combinations of piston-flapper, dual-flap, etc.
- Dynamic calibration capabilities for accurate determination of wave machine response characteristics.
- Sophisticated wave machine compensation programs with extensive safety checks.
- Complete set of directional wave analysis programs.
- Reflection analysis programs for regular and random waves.
- Active absorption of waves reflected by test structures.

GEDAP programs are available in the following packages:

- **Basic Data Analysis** - a set of basic time-domain and frequency-domain programs for the analysis of data. Programs for filtering, integration, differentiation, and basis statistics are included in this package.
- **Advanced Data Analysis** - a set of advanced analysis programs for detecting and repairing noise glitches in files, advanced statistics, linear transformations, computing variance spectral densities, computing cross-correlations, and zero-crossing wave analysis are included in this package.
- **2D Wave Analysis** - a set of analysis programs for the analysis of waves in wave flumes. Programs in this package include: reflection analysis, cross-mode analysis and spectral matching.
- **3D Wave Analysis** - a set of programs for directional wave analysis using the Maximum Entropy Method and the Maximum Likelihood Method.
- **2D Wave Synthesis** - a set of programs to synthesize waves for a wave flume. Programs in this package include: dynamic calibration of wave generators, synthesis of wave spectra using parametric models, synthesis of random wave trains for a target spectrum and wave machine drive signal creation. Control over spurious long-wave components and the generation of episodic waves are also supported.
- **3D Wave Synthesis** - a set of programs to synthesize waves for a 3D wave basin. Programs in this package include: computation of various cosine-squared spreading functions, generation of long-crested wave trains and dynamic calibration of segmented wave generators.

Removal of WaveGen-Studio

The WaveGen-Studio software can be uninstalled using the WaveGen-Studio Installer or through the Windows Control Panel. To remove the software using the Installer, run the Installer and select Next in the Initial Install Window (Figure 44); then click Remove on the Change, Repair or Remove Window (Figure 45). Alternatively you can remove the WaveGen-Studio software using the Control Panel, click Start → Control Panel → Programs and Features. Locate the WaveGen-Studio program on the list and click Uninstall.

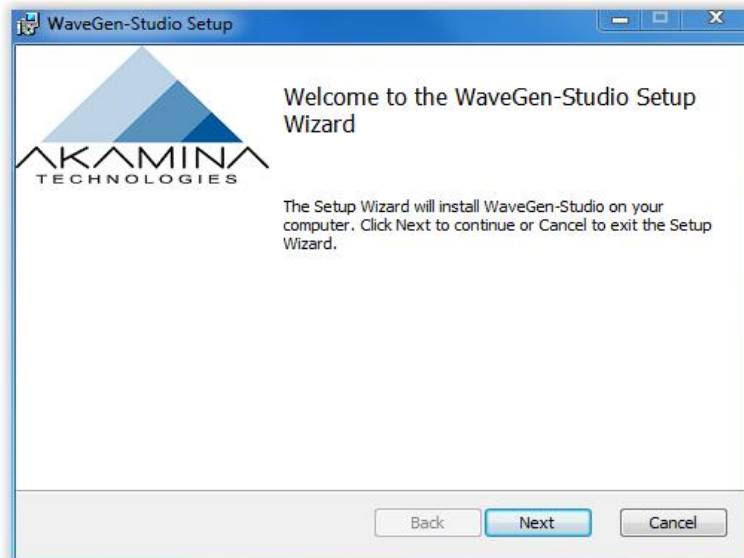


Figure 44: Initial Install Window

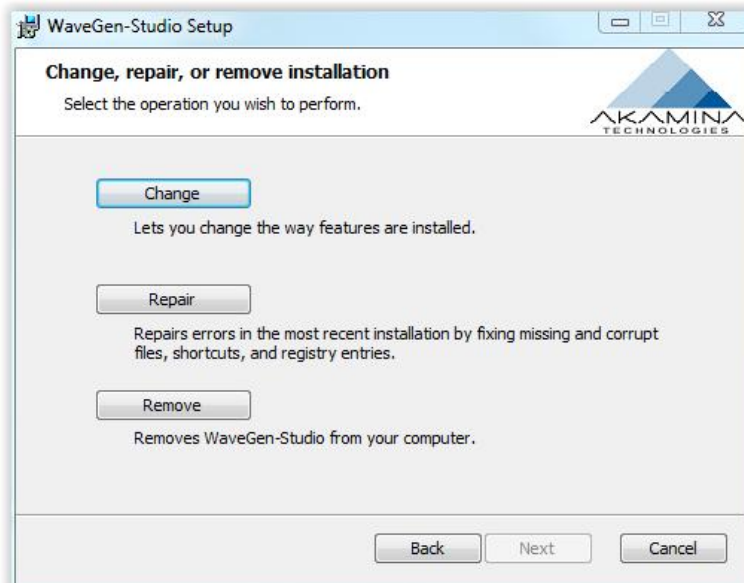


Figure 45: Uninstall WaveGen-Studio Window

Removal of GEDAP

The removal procedure for GEDAP is similar to the removal of WaveGen-Studio.

Using GPLOT

GPLOT is an extensive interactive graphics package that allows GEDAP data files to be easily examined at any stage of the analysis process. GPLOT Features include:

- Interactive or batch mode operation.
- Automatic scaling and automatic axis labelling using information from the data file header.
- Choice of linear, logarithmic or probability axis scales.
- Choice of line patterns, line widths and colours for plotting curves.
- Various fonts are available for labelling plots.
- Support for embedded LaTeX commands in text strings for Greek characters, math symbols, accents, subscripts, superscripts, etc.
- Dynamic objects such as text strings, boxes, arrows, etc. that can be positioned with a mouse when designing plots.
- Multiple datasets per graph and multiple graphs per page with up to 262,144 points per dataset.
- Automatic generation of plot legends to identify the various datasets in a plot.

The GPLOT package is started by opening a Command Prompt and entering the string: GPLOT. This will open the GPLOT interface. It may be helpful to change to the correct working directory before starting GPLOT as this will simplify the plotting operations.

Additional information on GPLOT is included with the GHELP information.

Licensing

WaveGen-Studio and GEDAP requires a license file to run. The type of license you have purchased determines the functionality available in WaveGen-Studio and in GEDAP. The tab items and button items that are visible in the ribbon control area will also vary accordingly.

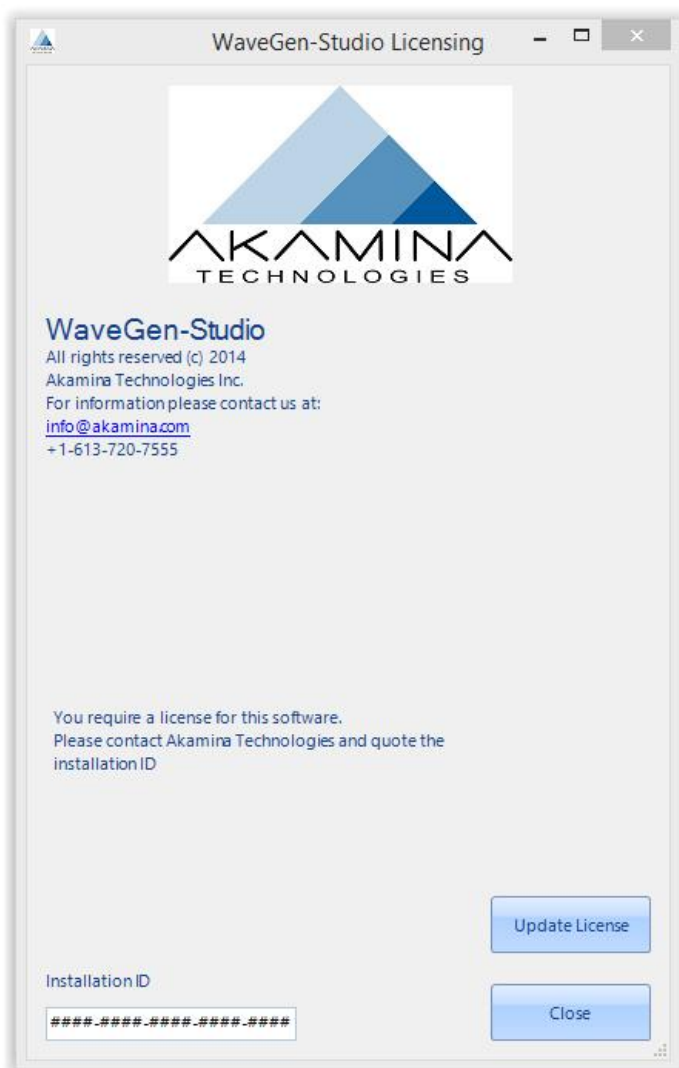


Figure 46: WaveGen-Studio Licensing Window

Some typical capabilities controlled by the license are:

- Number of servers the user can connect to,
- Basic or Advanced Data Analysis,
- 2D or 3D Synthesis and
- Wave Generation.

After the first installation, no license file will be present and opening WaveGen-Studio will present you with a window as shown in Figure 46. Make a note of the installation ID displayed at the bottom of the window - you will need to provide this to Akamina for your license. Call the phone number or send an email to the contact information displayed on the screen. You will be required to provide the installation ID displayed at the bottom of the window along with an email address. Using the Installation ID, Akamina will generate a license file that will permit for the full functionality of the software package purchased and send it to the email provided.

This license file must be saved on your computer. Remember where it is located as you will need to identify its directory path during installation. This license will be bound to the computer it is installed upon. To activate the license file click the Update License button and in the windows pop up, browse to the directory containing the

license file, select it and click Open. On validation, the License window will then be updated to display the features that are included in the license file. The features are listed in the middle of the pop-up window positioned after the Akamina Logo. Close the Licensing window; and reopen WaveGen-Studio to gain user access to the licensed software.

Note: the Installation ID presented in the licensing window uniquely identifies the PC on which the software is to be installed. The license file generated with this ID binds the single copy of the software to this PC.

Exporting Data

The Export interface accessed via the FILE tab pull-down menu shows a list of the acquisitions available for export sorted by start date and time to appear. The channel numbers from which data was acquired are listed under the column heading # Channels. An example of the FILE → Export pop-up window is shown in Figure 47. To select a data file for export, double-click the desired row or select it and click the OK button and the save interface will open. The Show button opens a pop-up window with more detail of the file content.

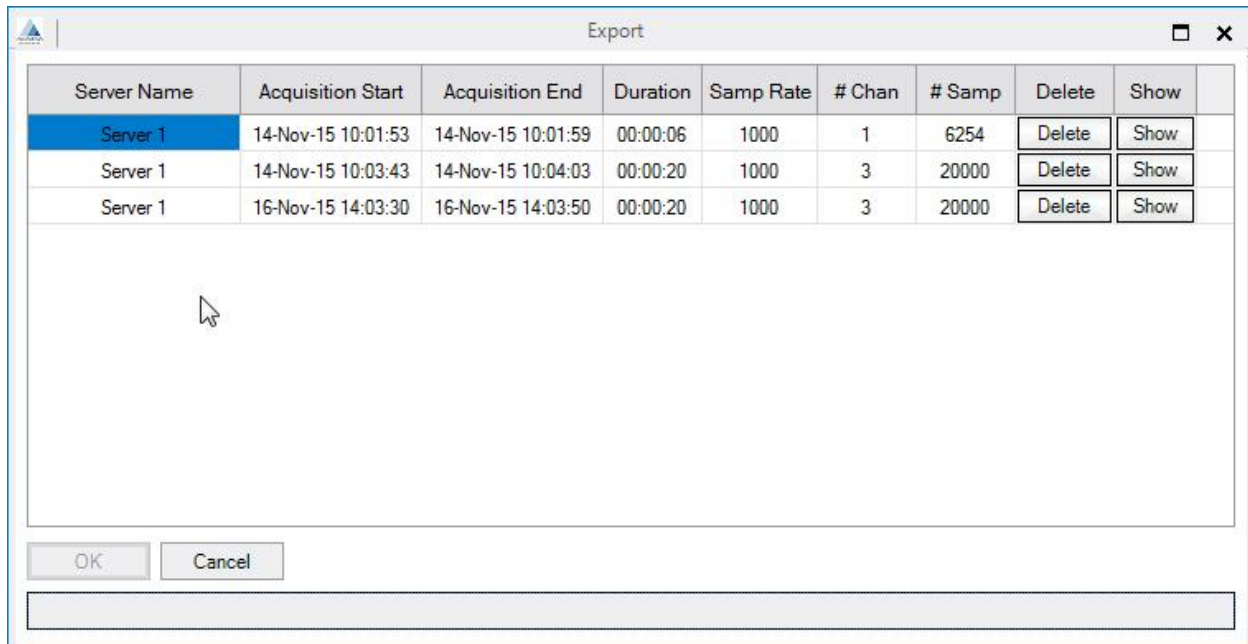


Figure 47: FILE → Export Pop-up Window

File→Export shows a list of acquisitions available to be exported. Once one of the acquisitions has been selected, the OK button becomes available. Double-clicking a row has the same effect as selecting and pressing OK -- at which point the export filename is requested from the user and the choice of output format is made:.

- If CSV is selected, the default extension is CSV (but the user can override this), and a single file will contain all the data of this acquisition.
- If GEDAP is selected, then the default filename shown is .001, but there will be a separate file created for each channel in the acquisition. The first channel will have an extension of 001, the second will be 002 and so on. Whatever extension the user may type in at this point is ignored, and the actual extensions will be as described.

Once a folder has been chosen and a filename has been entered, the OK button is disabled again, and the export process begins. Note that the Cancel button is still available, and in this phase the export can be interrupted and cancelled. The progress bar under the OK and Cancel buttons shows the percentage completed of the export operation. When the operation completes successfully, the dialog is automatically closed.

A Calibration Example - AWP-300

This example captures a typical calibration procedure for AWP-300 wave height gauges. Calibrating other sensors proceeds in a similar fashion only there is no need to configure other sensors the way that AWP-300s are configured.

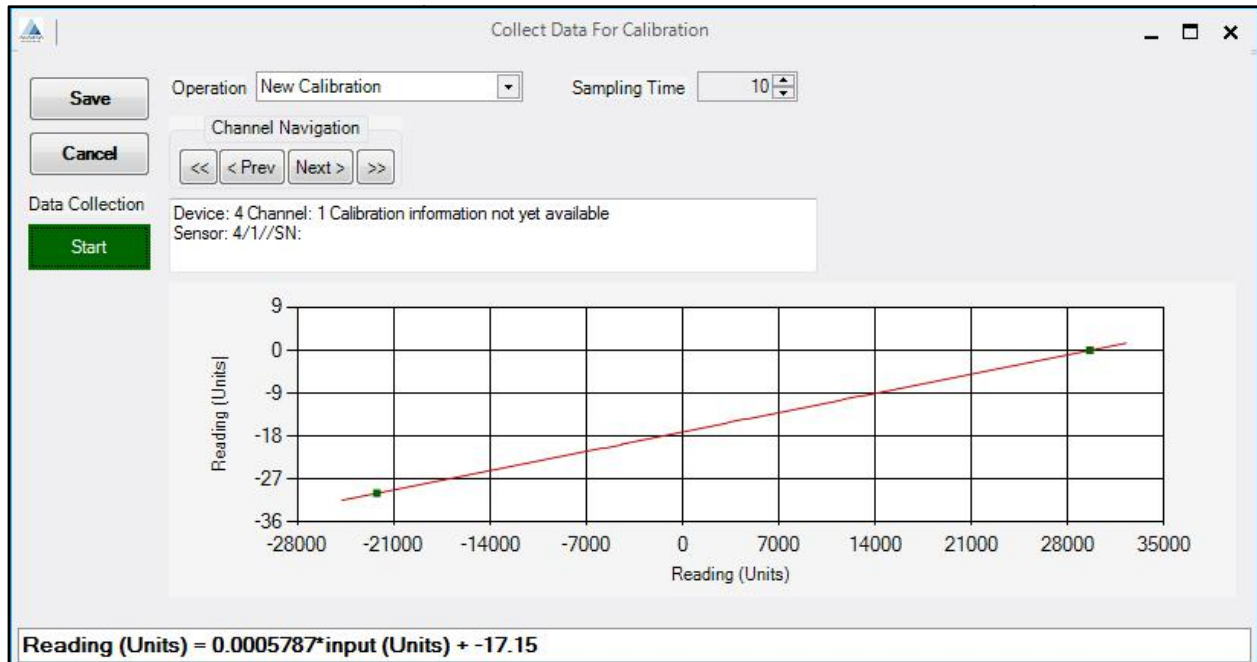


Figure 48: Calibration After Two(2) Data Points

Selected figures taken during the calibration procedure are included below:

- After 2 data points have been added to the calibration (see Figure 48).
- After 5 data points have been added to the calibration (see Figure 49).
- After re-zeroing the sensor to adjust the 0 position (see Figure 50).

Step 1: Configure Sensor(s):

1. Move to the ACQUIRE → Setup → AWP-300 Interface.
2. Click on Discover Sensors button and assign the discovered sensors using the Assign Sensors button.
3. Select the sensors you wish to use and submerge the wave probe heads to the maximum immersion depth.
4. Under Change Selected, click Configure.

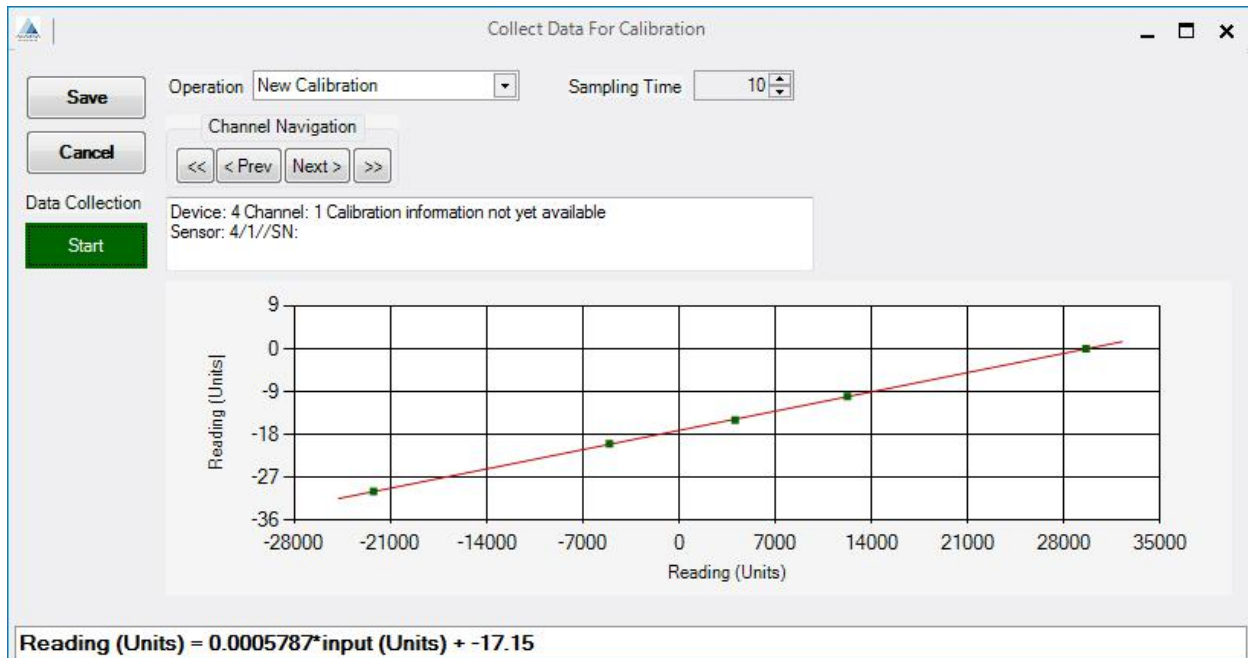


Figure 49: Calibration after Five (5) Data Points

Step 2: Calibrate Sensor(s):

1. Ensure that the server is active.
2. Select the channels to be calibrated (Calibrate → Channels).
3. Move to the Calibrate → Collect interface.
4. Adjust the Sampling Time if necessary.
5. Click on Data Collection to acquire the raw data for a calibration data point. When the sampling stops (either by pressing Data Collection a second time or the Sampling Time expires), examine the summary statistics for the acquired data and enter the reference value to be associated with the data point.
6. Repeat Data Collection until the desired number of data points has been acquired.
7. Select Save to save the calibration data or select Cancel to discard the data.

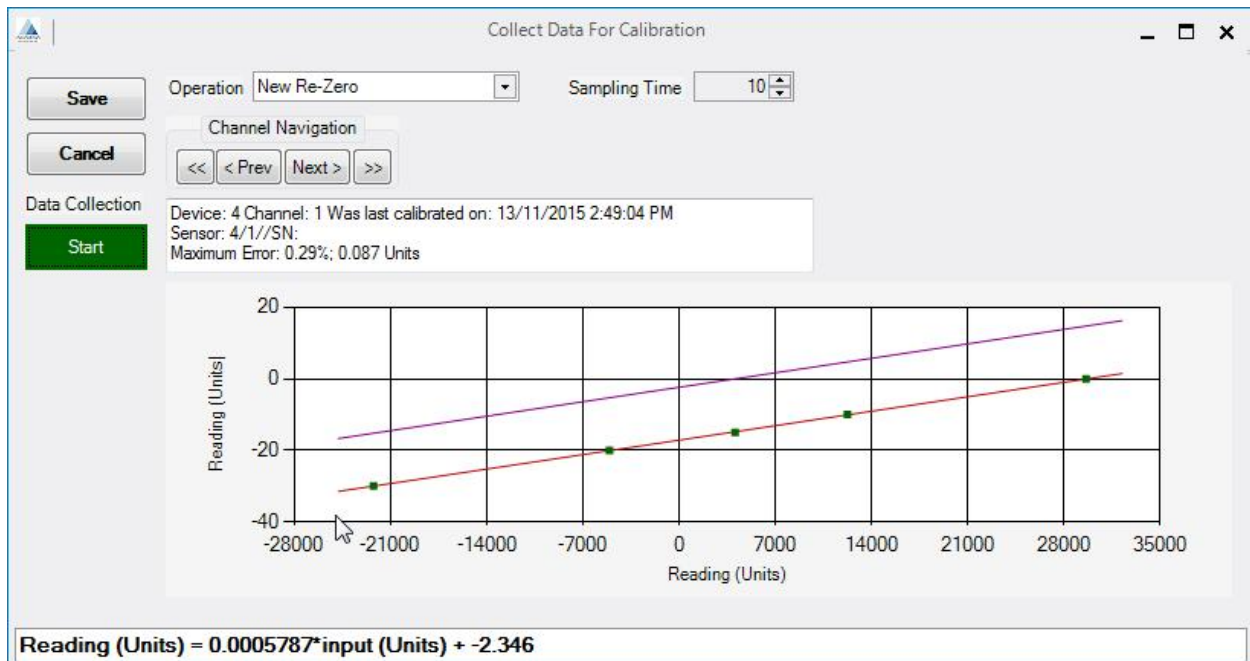


Figure 50: Calibration with Re-zero Curve