Princeton Applied Research

VersaSCAN™

Electrochemical Scanning System Software Manual



P/N 224215 Rev. B

AMETEK®

This document describes the framework of the VersaSCAN software. Details on creating projects and experiments for handling data acquisition as well as graphs for data presentation are provided.

An accompanying document provides specific information on hardware set-up and specifics of each technique.

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1. Software Launch

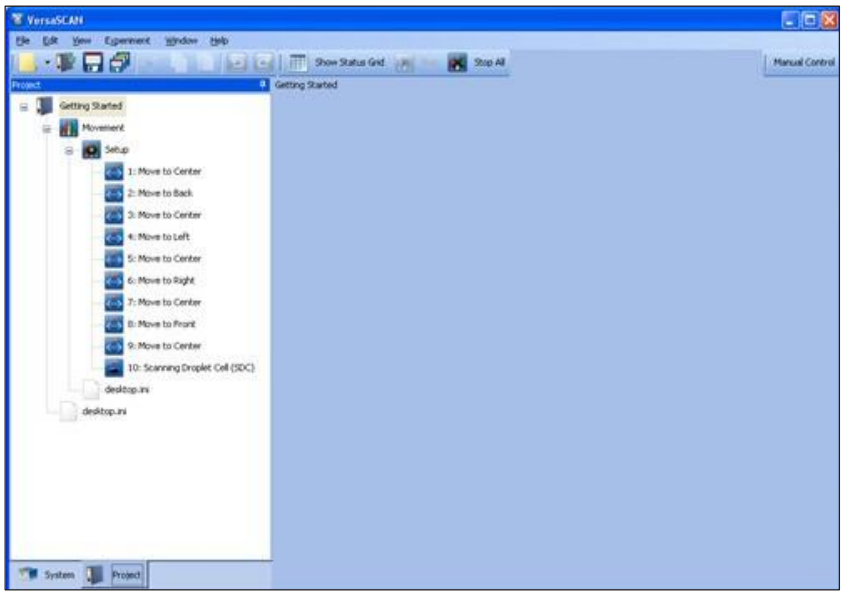
The VersaSCAN software controls the VersaSCAN system.

Use the desktop icon 

on the provided laptop to launch the software. This splashscreen with Version number will appear as the software is launched.



When the software first opens, a screen such as this one is displayed.

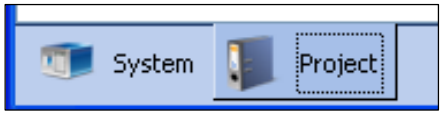


This screen has a left-hand navigation panel containing a structure of items representing the most recently opened project. The Getting Started project appears by default when VersaSCAN is first installed and run.

The software will launch into a predefined “Getting Stared” project. Within this project, there is a “Movement” experiment, which consists of several steps.

There are two tabs at the bottom of the left-hand navigation panel:

- System. This tab displays the User Preferences and Equipment Library.
- Project. This tab displays the currently open project.

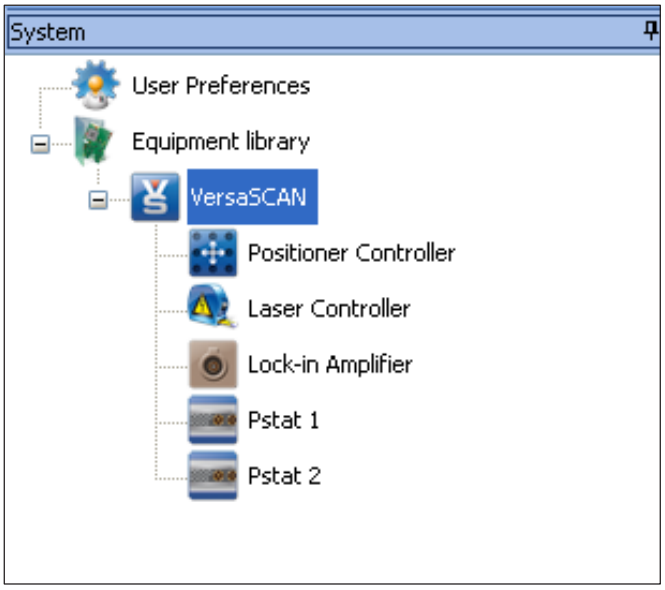


2. System

1. Make sure there is an open project, so that the project name (for example Getting Started) appears in the left-hand navigation panel when the Project tab is selected. If the navigation panel is blank, open a project using Open Project or Recent Projects from the File menu. Any project will do, for the purpose of checking the system communications, but it will be convenient to open the Getting Started project because it will be needed for the Installation Tests.

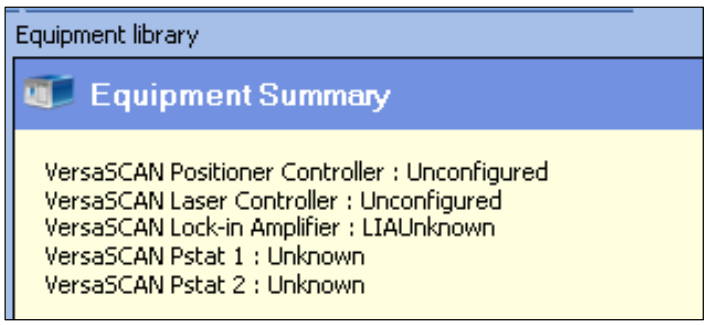
   NOTE: If there is no open project (because it has been closed using Close Project from the File menu), the left-hand navigation panel will be blank, regardless of whether the System or Project tab has been selected. The information under the System tab does not belong to the project, but a project has to be open in order to display it.

   2.Click on the System tab at the bottom of the left-hand navigation panel to display the User Preferences and Equipment library as follows:



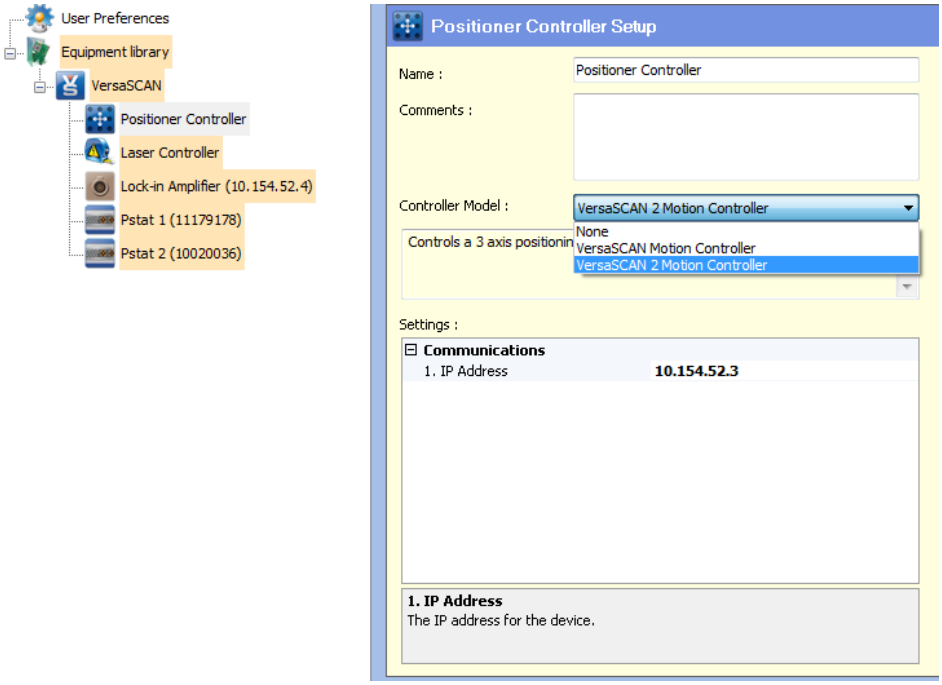
The User Preferences define features of the VersaSCAN software that are specific to the user of Windows, and do not need to be changed at this stage. The Equipment Library is defined during this system installation.

Click on the Equipment Library to display the VersaSCAN. A right-click on the Equipment Library will display the Equipment Summary.



Connectivity of the Positioner Controllers, Laser Controller and Lock-in Amplifier are Ethernet. Connectivity of the Potentiostats is by USB.

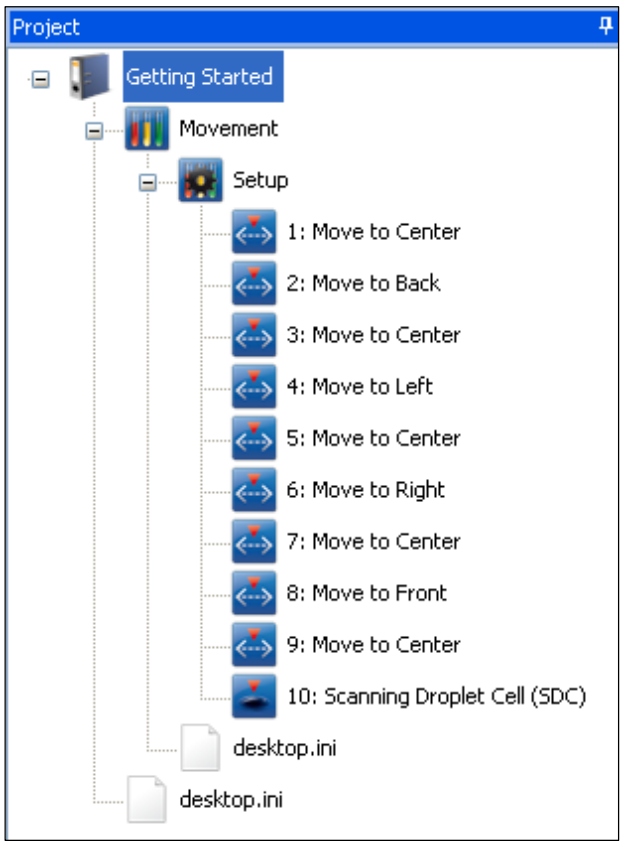
These IP Addresses are set at the factory, but for reference:
IP Address X-Y Controller is set to 192.168.10.11
IP Address Z Controller is set to 192.168.10.12
IP Address of the Laser Controller is 192.168.10.10
IP Address of the Lock-in Amplifier is 192.168.10.9



Two position controllers are enabled in VersaScan. You must configure the controller depending upon the model you are using. It is easy to determine the model. If your system is uses TWO motion controller boxes (XY and Z) then select VersaSCAN Motion Controller in the controller Model box. If your system uses a VersaSCAN 2 Motion Controller, then select this from the drop down list.

3. Project

When the Project tab is selected and the tree structure is expanded, the navigation panel is as follows (using a different project in this case instead of Getting Started, with a wider range of features):



3.1 PROJECT STRUCTURE

The top level item is the project name, in this case Getting Started. This contains a structure of items, and may include general purpose folders in which additional structures may be created.

A project or folder can contain the following items:

- **Experiment.** This gives a summary of an experiment and the control features that enable you to run it.
    - **Setup.** This describes how the experiment is to be performed, including the cell and the modules to be used. An experiment may contain loops and steps as follows:
        - **Loop.** This defines a set of measurements to be taken repeatedly, and may contain any number of steps either directly within the loop or in additional nested loops.
        - **Step.** This defines a scanning experiment.
            Move
            Delay
            Scanning Electrochemical Microscopy
            Scanning Vibrating Electrode Technique
            Scanning Kelvin Probe
            Capacitive Height Measurement
            Capacitive Tracking Measurement
            Scanning Droplet Cell
            Optical Surface Profiler
            Localized Electrochemical Impedance Spectroscopy

step types are listed under their appropriate category when a new step is added. You can select a step type from the list and an appropriate screen will appear, and then you can specify the detailed configuration. Steps can exist directly under an experiment Setup, or they can be within loops, to take repeated measurements.

- **Data.** This is generated by running experiments and obtaining results which are displayed as tabulated lists and graphs. If the experiment contains loops and sub-loops, the data will be generated at multiple levels in the tree structure. A data filename is specified when the experiment is run, although it defaults to the experiment name.

- **Graph.** This is a graphic display feature that can access the data generated by experiments and display it with the appropriate axes. This feature can be added to a project independently of any experiments, and then the data from different experiments can be imported for display and comparison. Alternatively, it can be created from a data item, after running an experiment, and will access all the results of the experiment by default.

Graphs can be added at multiple levels within the *project*, either directly under the *project*, or under an *experiment* or *folder*.

3.2 Folders

VersaSCAN uses a system of files and folders, based on the Windows directory structure, to build projects. The project itself is a folder directly under the VersaSCAN folder, so that the pathname for the Example Project might be:

C:\My Data\VersaSCAN\Example Project

The project may contain experiments, which are also folders. A folder representing a project or experiment has a specific meaning in VersaSCAN, so that it is recognized from its contents and the appropriate item appears in the left-hand navigation panel. Underneath a project or experiment, you can add sub-folders for general purpose use, with the default name “Folder”, and they can be used as a location for other items including other experiments.

3.3 Editing the Navigation Panel

The tree structure in the navigation panel can be modified in a number of ways.

- New items can be added where appropriate, under the currently selected item, by selecting Add new from the File menu or toolbar, or from the drop down menu that appears when right-clicking the item. The available items depend on the current position in the tree structure.
- Items can be cut, copied, pasted or deleted, using the Edit menu or toolbar, or the drop down menu that appears when right-clicking the item. However, to maintain the structure of the project, these features are only available where appropriate, otherwise they are greyed out.
- Items can be moved from one position in the tree to another, by dragging them up and down, but only in circumstances where the structure of the project can be maintained.
- Items can be renamed so that they represent the features of your experiment. To rename an item, click once to select it, then click again, then re-type the name. This feature is not available for the data items generated from an experiment, but is available for the folders in which they are held.

3.3.1 Navigation Drop Down Menu

When you right-click on an item in the navigation panel, a drop-down menu appears, including sub-menus, containing commands which are mostly from the Menu Bar, and are appropriate for the item.

The following commands are specific to the drop-down menu and do not exist in the Menu Bar:

Rename Experiment

This command is only available when a data folder or sub-item is selected from the navigation panel, and recreates the experiment that was used to generate the data. This is useful if you receive some data from a third party and wish to run the experiment.

Explorer

This command opens Windows Explorer at the location in the filing system that represents the currently selected item in the navigation panel. This might be useful, for example, it you want to copy part of the system configuration or data to another part of the filing system, for backup purposes.

3.4 Filenames and Extensions

The VersaSCAN project structure is based on the Windows filing system, with the project as a top level folder. Within this structure, files with certain extensions are recognized by VersaSCAN and interpreted to create the structure in the navigation panel. For example:

- Files with the INFO extension contain general information about the project.
- Files with the DATA extension contain data generated by experiments.

If a file exists within the structure, that is not recognized by VersaSCAN, or has been created by VersaSCAN for use with other applications, it will appear in the navigation panel complete with the file extension. This will include CSV files containing exported data. When one of these files is selected in the left-hand navigation panel, a File Information dialogue box will appear.

3.5 Menu Bar

3.5.1 File Menu

Add New

Add a new item under the currently selected item in the navigation panel. A sub-menu of available additions will appear, otherwise this menu item is greyed out. The available items, according to the current selections, are as follows:

Selected Navigation Panel Tab	Selected Item	Items available for addition
System	Equipment Library	VersaSCAN
		Positioner Controller *Laser Controller* *Lock-in Amplifier* *Potentiostat 1* *Potentiostat 2*
Project	*project*	*folder** *experiment* *graph*
	*folder**	*folder** *experiment* *graph*
	experiment	*folder** *graph*
	setup *(appears automatically under experiment)*	*Step* *loop*
	loop	*step* *loop*

** A folder that has been added for general purpose use, not representing a project, experiment.*

- *New Experiment and New Step in the Experiment menu. These have the effect of adding items directly under the appropriate top level items (project, experiment or experiment Setup), regardless of the sub-item that has been selected.*

New Project

Create a new *project*. A dialogue box appears in which you can specify a *project* name and various other features, and then the *project* appears in the navigation panel with the Project tab selected.

If a *project* is already open, containing items that have changed, the Close Project dialogue box will appear, so that you can specify the items that need to be saved, then the *new project* will appear.

Open Project

Open a *project* that has previously been created. A filing system browser window appears, with an appropriate folder selected (depending on previously opened projects), and you can expand the folder and select the *project* to be opened, then click OK. The project will appear in the navigation panel with the Project tab selected.

If a *project* is already open, containing items that have changed, the Close Project dialogue box will appear, so that you can specify the items that need to be saved, then the new *project* will appear.

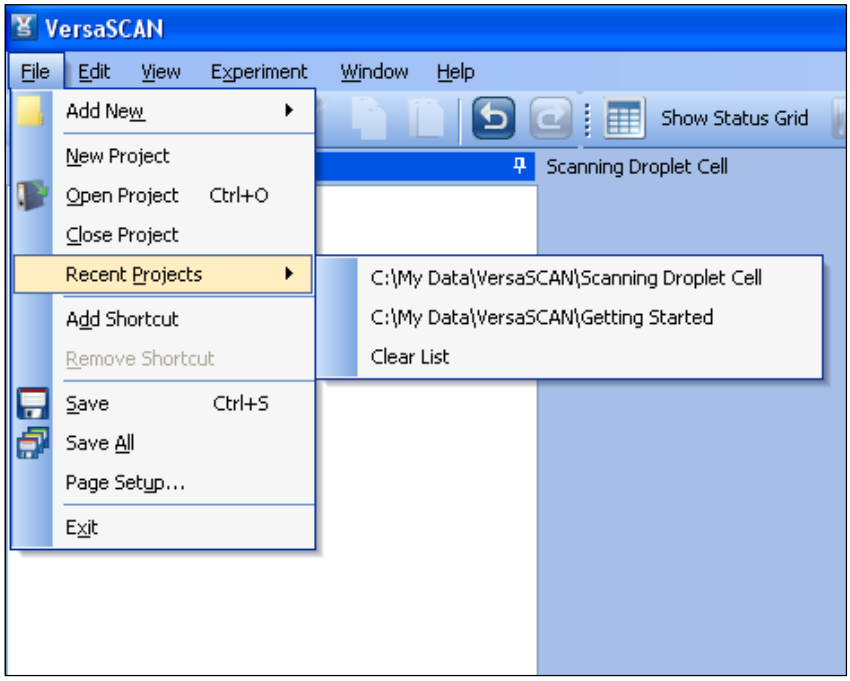
Close Project

Close the currently open *project*, so that it disappears from the navigation panel. The panel will become empty, including the features that normally appear under the System tab.

If changes to the *project* have been made, the Close Project dialogue box will appear so that you can save the changes, then the project will close.

Recent Projects

Display a list of recently opened projects as follows:



When a project is selected from the list, it will open in the navigation panel and any currently open *project* will be closed.

If changes to the currently open *project* have been made, the Close Project dialogue box will appear so that you can save the changes, then the *project* will close.

If Clear List is selected, all *projects* will be removed from the list so that next time it appears it will display List Empty!

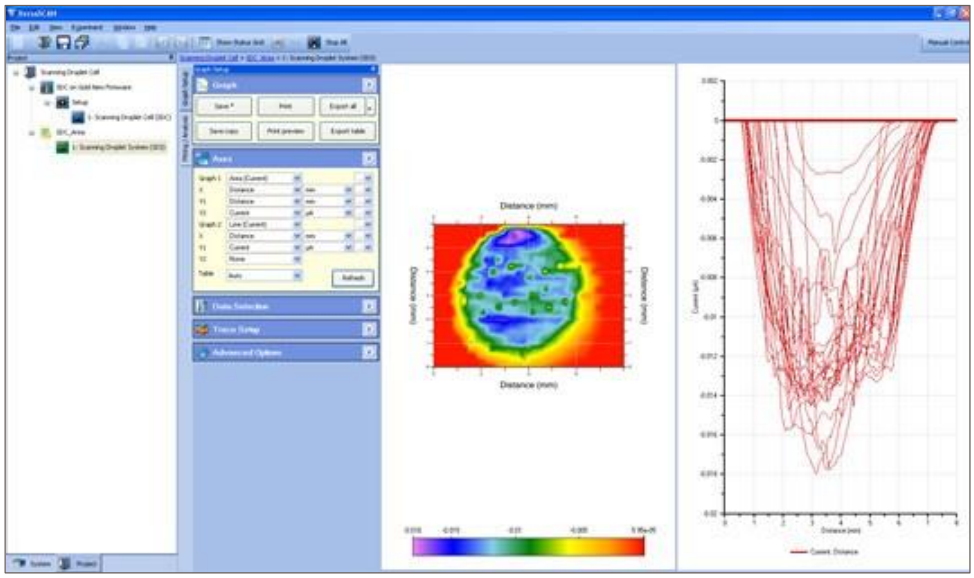
3.6 DATA



When an experiment is run, a data item representing the results will appear in the left-hand navigation panel, with a structure of sub-items based on the structure of the experiment. When an item in the data structure is selected, measurements will appear in the right-hand window in the form of graphs and a tabulated list, depending on the configuration of the Axes sub-screen.

The graphs and tabulated list will be updated as the experiment progresses and new measurements are taken, until the activity represented by the selected item is complete. Each item in the data structure is linked to a corresponding item in the experiment structure.

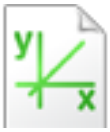
For example, the following structure has a data item called Scanning Droplet Cell, and when selected it displays the results of the corresponding step in the experiment.



The data structure in this example is as follows:

- At the top level there is the data file name that is specified when the experiment is run.
- At the next level there is the step, identified by the step type.

3.6.1 Graph



This sub-screen in the data screen contains a set of buttons so that you can save, print and export the currently displayed results.



The buttons are as follows:

Save

Save the data as a Graph File which appears in the navigation panel. If this button is used more than once, the Graph File is overwritten.



An asterisk appears alongside the Save button if any changes have been made to the graph, since it was last saved, by editing the associated sub-screens (Axes, Data Selection, Trace Setup and Advanced Options). The asterisk disappears next time the Save button is used.

Save Copy

Save the data as a Graph File which appears in the navigation panel. This button is the same as the Save button, but in the Graph File, which has the same set of buttons, it has a different functionality.

Print

Open a print dialogue box and print the displayed graph. If there are two graphs they will be printed on separate pages.

Print Preview

Display a preview of the graphs before printing.

Export All

Export the data as an appropriate file type, depending on your selection from the list box at the right of the button. The options are:

Text	Export the data as a CSV file, which appears in the navigation panel, and display the results in the default application for this file type (for example Excel). The complete data set is exported, regardless of the displayed table. This is the default option, and is used if you click the button without selecting anything from the list box.

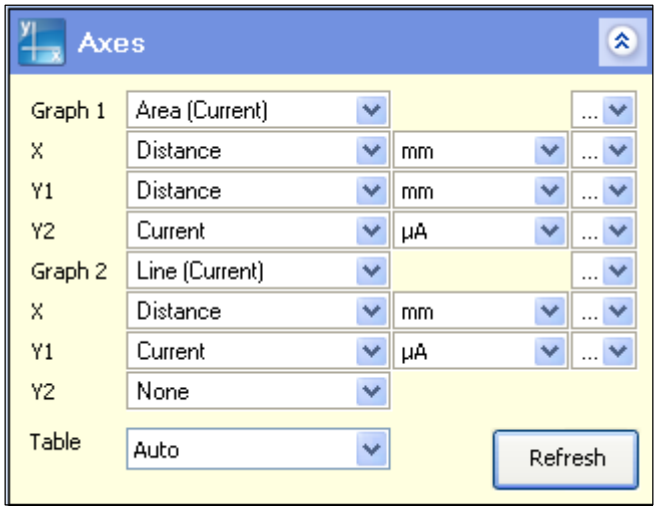
Export Table

Export the data as a CSV file, which appears in the navigation panel, and display the results in the default application for this file type (for example Excel). The data is filtered so that a maximum of 2000 points are exported.

You can close the application and open it again from the File Information dialogue box.

3.6.2 Axes 

This sub-screen in the data screen enables you to specify the axes on which the data is to be displayed. By default they will be the same as the Graph Setup for the step in which the data was created.

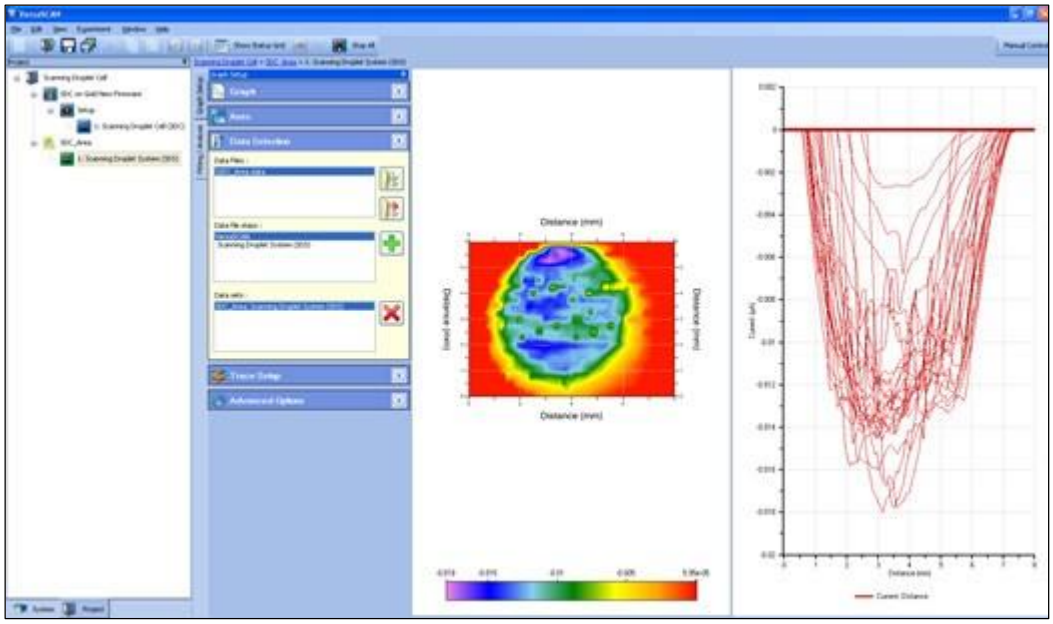


The fields follow the general layout of graphic displays.

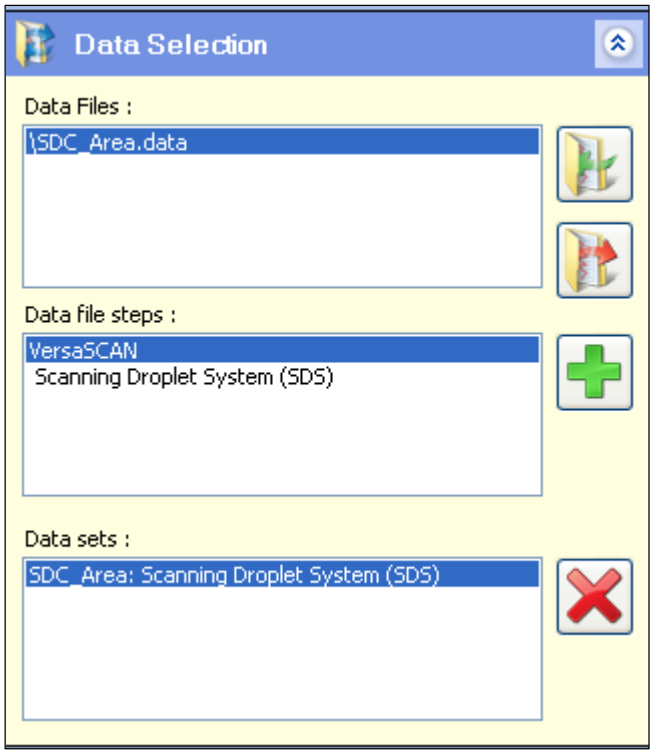


3.6.3 Data Selection

This sub-screen in the data screen enables you to specify the axes on which the data is to be displayed. By default they will be the same as the Graph Setup for the step in which the data was created.



An enlarged view of the Data Selection panel is as follows:



This example shows what the sub-screen might look like after running an experiment just once and selecting a step from underneath a data folder called SDC_Area. The pathname of a data file called SDC_Area.data appears in the upper panel, and a series of steps appears in the middle panel, under the group name VersaSCAN. The lower panel displays the step that has been selected from the left-hand navigation panel.

The fields are as follows:

Data Files

This window displays a list of data files generated by experiments. Initially there is just one file corresponding to the results of this experiment, but other files can be added, for the purpose of comparison. The additional files can be created by running the same experiment several times, or by running other experiments, and then the data files can be imported into this sub-screen. If a file is no longer required in the list, it can be removed.

When you click on a file, the list of steps within the file will appear in the Data file steps window



This button opens a dialogue box so that you can browse for a data folder and add it to the Data Files window. Only folders are displayed, not the files within them, and you can only add folders with the DATA extension. If you try to add any other folder, the system will return an error.



This button removes the selected folder from the Data Files window.

Data file steps

This window displays the complete list of steps within the file that has been selected in the Data Files window. You can select any step from the list and add it to the Data sets window, for graphic display.



This button adds the selected step in the Data file steps window to the Data sets window.

Data Sets

A data set is the data generated by a single step in the experiment, and this window contains a list of data sets to be displayed in the graphs and tabulated lists. By default, it contains a single data set generated by this experiment, but other data sets can be added from the Data file steps window.

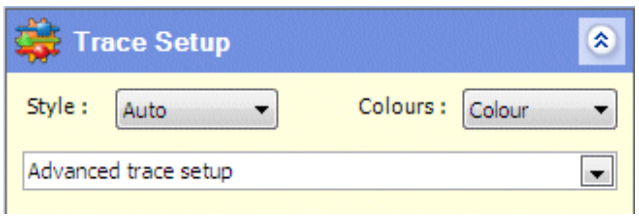


This button removes the selected step from the Data sets window.

3.6.4 Trace Setup



This sub-screen in the data screen enables you to define the appearance of the graphs, in terms of line types, colors and symbols.



The fields are as follows:

Style

This list box displays lines or symbols on the graph, as follows:

Auto	Automatically choose to display data as lines or symbols on the graph, depending on the number of measurement points.
Lines	Display data as lines on the graph.
Symbols	Display data as symbols on the graph. There will be one symbol for each measurement taken.
Both	Display data as both lines and symbols.

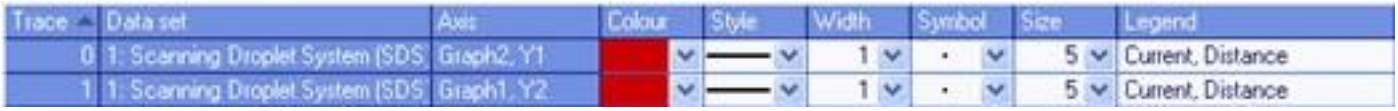
Colors

This list box specifies how colours are to be displayed on the graph, as follows:

Colour	Change all traces to their default colours
Black	Change all traces to black.

Advanced Trace Setup

When this list box is clicked, a popup window appears as follows:



This window contains a number of properties that you can apply to the lines and symbols on the graph. There is a header row, followed by one row for each data set, graph and vertical axis that is displayed.

The fields are as follows:

Trace
The trace number, starting at 0 and incrementing by 1 for each successive row.

Data Set
The data set name, according to the list in the Data Selection sub-screen (which defaults to the item selected from the left-hand navigation panel).

Axis
The graph number (Graph 1 or Graph 2) and the axis, (Y1 or Y2).

Colour
The color of the trace. The list box displays a color palette.

Style
The line style used for the trace. The list box displays a list of styles (continuous, dotted, dashed, etc.)

Width
The line width used for the trace. The list box displays a list of numeric values from 1 to 5.

Symbol
The symbol used for each data point on the trace. The list box displays a list of symbols (circles, squares, etc.)

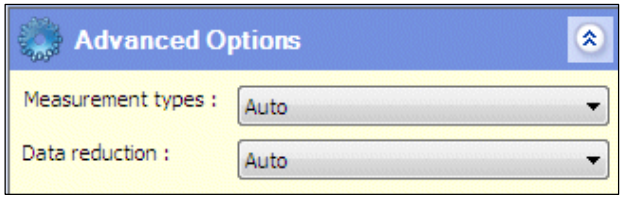
Size

The size of the selected symbol. The list box displays a list of odd numbers from 1 to 15.

Legend
The legend for the axis. The text field defaults to the selected units, but you can change it.

3.6.5 Advanced Options

This sub-screen in the data screen enables you to specify options for data reduction, to speed up the drawing of graphs that would otherwise involve a large number of measurement points.



The fields are as follows:

Measurement types

This list box specifies the type of measurement to which filtering is applied. The options are:

Auto	The system automatically selects All Measurements or Impedance Only, depending on which one is most appropriate. This is the default option.
All measurements	Apply data filtering to all measurements.
Impedance only	Discard all DC measurements and apply data filtering to the impedance measurements only.

Data reduction

This list box specifies the type of data filtering to be applied. The options are:

None	Display all data points without filtering. This option should not be used if there are more than a million points, or while the experiment is running.
First	Display the first 2000 points.
Last	Display the last 2000 points. When 2000 points have been accumulated, the oldest ones will be discarded.
Regular	Display every n'th point, where n is calculated so that 2000 points are displayed.
Random	Divide the data into 2000 sections, each containing an equal number of points, and display one point at random from each section.
MinMax	Divide the data into 1000 sections, each containing an equal number of points, and display the minimum and maximum values from each section.
Regular	Time Display every n'th point, where n is calculated so that 2000 points are displayed, each from an equal time interval.
MinMaxTime	Divide the data into 1000 equal time intervals, and display the minimum and maximum values from each interval.
Auto	The system automatically chooses an option from the list, depending on what is most appropriate for the data, which may include DC or impedance measurements. This is the default option.

3.7 Graphic Displays

Graphic displays are generated by the VersaSCAN system and are available both during and after an experiment.

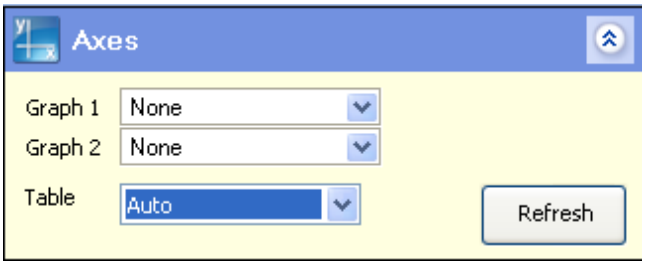
The data generated by experiments is divided into data sets for each step. The layout of the graphs in each data set is defined in the Graph Setup sub-screen for the step, and there is an option to use the default layout for the step type, defined in the Graph Preferences screen. The layout can subsequently be changed, when the results have been generated, using the Axes sub-screen. In each of these screens, where graphs are defined, the general layout is the same.

Data from other experiments can be retrieved into the data file, including data that has been generated by users of other VersaSCAN systems. Sub-sets of data from multiple experiments can be compared with each other, so that this feature provides a powerful tool for data analysis.

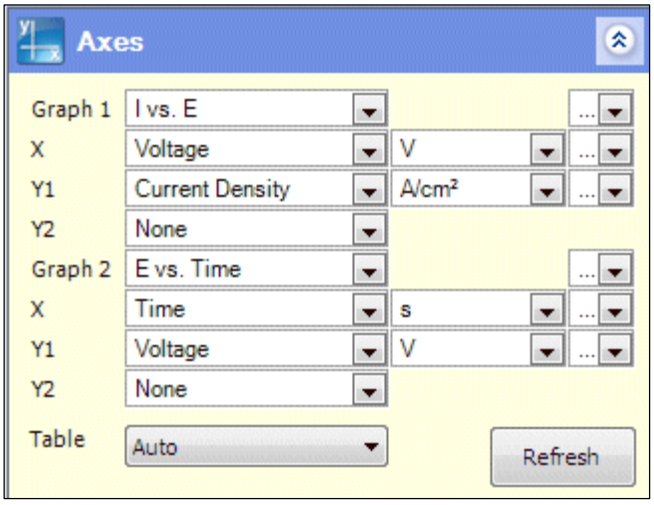
Data from any experiment can also be displayed using the Graph file. This has the same graphic display features as the data file, but it can be manually added to the system and does not need to be generated by an experiment. It also makes the data available to reports.

3.7.1 Layout of Graphic Displays

Graphic displays are defined in a number of different dialogue boxes in the VersaSCAN software, but they have the same general layout, with fields for defining two graphs called Graph 1 and Graph 2. The following screen defines the Axes for a step and includes an option to use the settings from the User Preferences.



When an experiment has been run and results are generated, the Axes sub-screen is available so that you can change the displays.



Note: This window contains a Refresh button to redisplay the graphs and tabulated data after changing the fields.

Graph 1, Graph 2

The type of graph to be displayed. Two graphs can be displayed simultaneously, with axes depending on the selections from these fields. The options for DC plots are as follows:

None

Line (Voltage)

Line (Current)

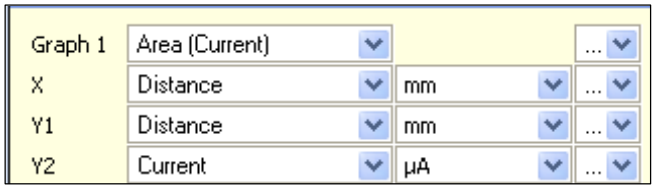
Line (Height)

Area (Voltage)

Area (Current)

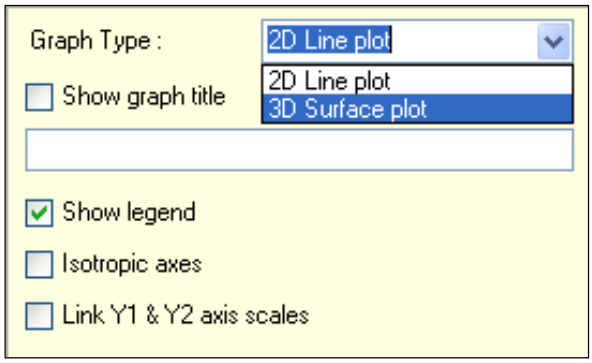
Area (Height)

If anything other than “None” is selected, a drop-down box appears alongside the Graph 1 or Graph 2 list box, and the display is expanded with the X, Y1, Y2 fields as follows:



Graph 1, Graph 2 (details)

The drop-down box alongside the Graph 1 or Graph 2 list box displays the graph configuration details as follows:



The fields are:

Graph Type

This field changes the plot from a 2D Line Plot to a 3D Surface Plot.

Show Graph Title

If this box is checked, the title specified in the text box will appear above the graph.

Show Legend

If this box is checked, a legend will appear under the graph, representing each trace.

Isotropic Axes

If this box is checked, the axes are scaled so that the measurement units occupy an equal length on the X, Y1 and Y2 axes.

Link Y1 & Y2 axis scales

If this box is checked, the Y2 axis is mapped onto the Y1 axis and uses the same scale, so the left-hand vertical axis represents both Y1 and Y2. This box is checked by default for graph types representing real and imaginary values.

X, Y1, Y2

These represent the horizontal axis (X), the vertical axis (Y1) and intensity of color (Y2) which may be used in some graphs.



For each of these fields that displays a variable other than “None”, two additional fields appear to the right, a list box of units, and a drop-down box for configuration of the axis with labels, limits, tick marks, etc.

X, Y1, Y2 (units)

This field appears to the right of any axis field (X, Y1 or Y2) that has not been set to None. It has a drop-down list box of units which depend on the variable being displayed by the axis. For example, if the axis represents time, the available units are:

ms s
Minute
Hour
Day

X, Y1, Y2 (details)

This drop-down box appears to the right of the units field for any axis field (X, Y1 or Y2) that has not been set to None. It displays a detailed configuration of the axis.

Table

This list box appears at the bottom of the Axes sub-screen (but not the Graph Setup sub-screen) as follows:

Tabulated data may be displayed alongside the graphs at the appropriate positions. The options from the list box are as follows:

None	Do not display tabulated data.
Auto	Display tabulated data at the default positions specified in the Graph Preferences sub-screen in the User Preferences.
Right	Display tabulated data to the right of the graphs.
Bottom	Display tabulated data below the graphs.

Refresh

This button appears at the bottom of the Axes sub-screen (but not the Graph Setup sub-screen), and refreshes the graphs and tables according to any changes that have been made.

An amber warning icon appears alongside the button when changes have been made to the screen and the graphs need to be refreshed.

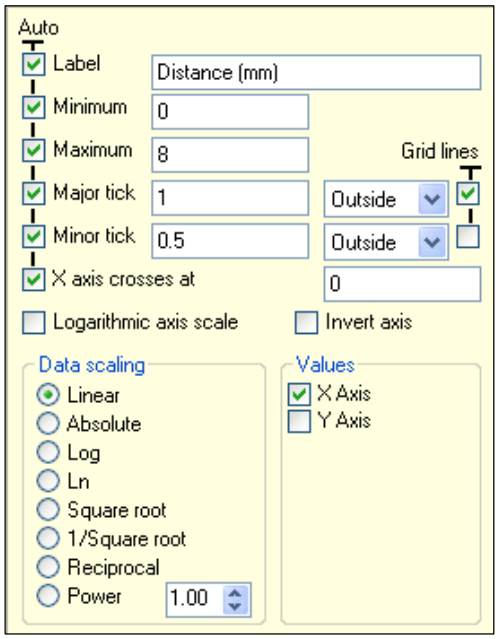
3.7.1.1 Axis Details

The Graph Setup and Axes sub-screens contain a set of fields representing the graph type and the X, Y1 and Y2 axes as follows:



Each axis field with an entry other than None has two additional fields, one for the units, and the other for additional details about the axis.

The drop-down box on the details field varies according to the quantity represented by the axis, but for Voltage it is as follows:



The default values for some of these fields depend on the graph type.

In this display, the fields are as follows:

Auto

In this group of fields, a check box is followed by one or more text or numeric fields. The boxes are normally checked, indicating that the fields are automatically given appropriate values, according to the displayed data, but if the fields are changed the boxes automatically become unchecked. The fields are:

Label
The axis label, which defaults to the variable and units represented by the axis.

Minimum
The minimum value of the variable to be displayed on the axis.

Maximum
The maximum value of the variable to be displayed on the axis.

Major tick
The interval at which major tick marks and values appear on the axis. The numeric field is followed by a list box with the following options:

None	Tick marks are not displayed.
Inside	Tick marks are displayed inside the axis.
Outside	Tick marks are displayed outside the axis.
Cross	Tick marks are displayed both inside and outside the axis.

Minor tick
The interval at which minor tick marks, without values, appear on the axis. The numeric field is followed by a list box, same as for major ticks.

X axis crosses at
This field specifies the value of the Y axis where the X axis crosses it. This is useful, for example, when placing the axis on zero, between positive and negative limits.

Logarithmic axis scale
The axis has a logarithmic scale. This box is checked by default if the axis for the graph type is normally logarithmic. The sign is ignored if the value is negative.

Invert axis
If this box is checked, the axis will be inverted so that the values increase in the reverse direction. (X axis from right to left, Y axis from top to bottom).

Data Scaling
The scaling of the data, before it is plotted, which can be one of the following, selected from a radio button:

Linear	No scaling applied
Absolute	Negative values converted to positive
Log	Logarithm to the base 10
Ln	Logarithm to the base e

Square root

1/Square root

Reciprocal

Power Scale the axis according to the power specified in the field alongside the radio button, for example:

2	Squared
3	Cubed
0.5	Square root
-1	Reciprocal

VersaSCAN™

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