GRAPH CURVE ANALYZER

Version 3.0

User Guide

Moscow, 2002

1 CONTENTS

2 INTRODUCTION

2.1 Application

The Graph Analyzer is developed for viewing and processing curves of functions of one variable.

The Analyzer is shipped in two versions: i) a stand-alone program, ii) a window in another program (e.g. as part of the MultiVox workstation). In the second case, the window may perform some extra functions not covered in this manual.

2.2 Requirements to User Skills

The user should have basic computer skills and study this manual.

3 DESCRIPTION OF OPERATIONS

3.1 *Graph* Window

The window is used for display and processing of curves (functions, Fig. 3.1-1).

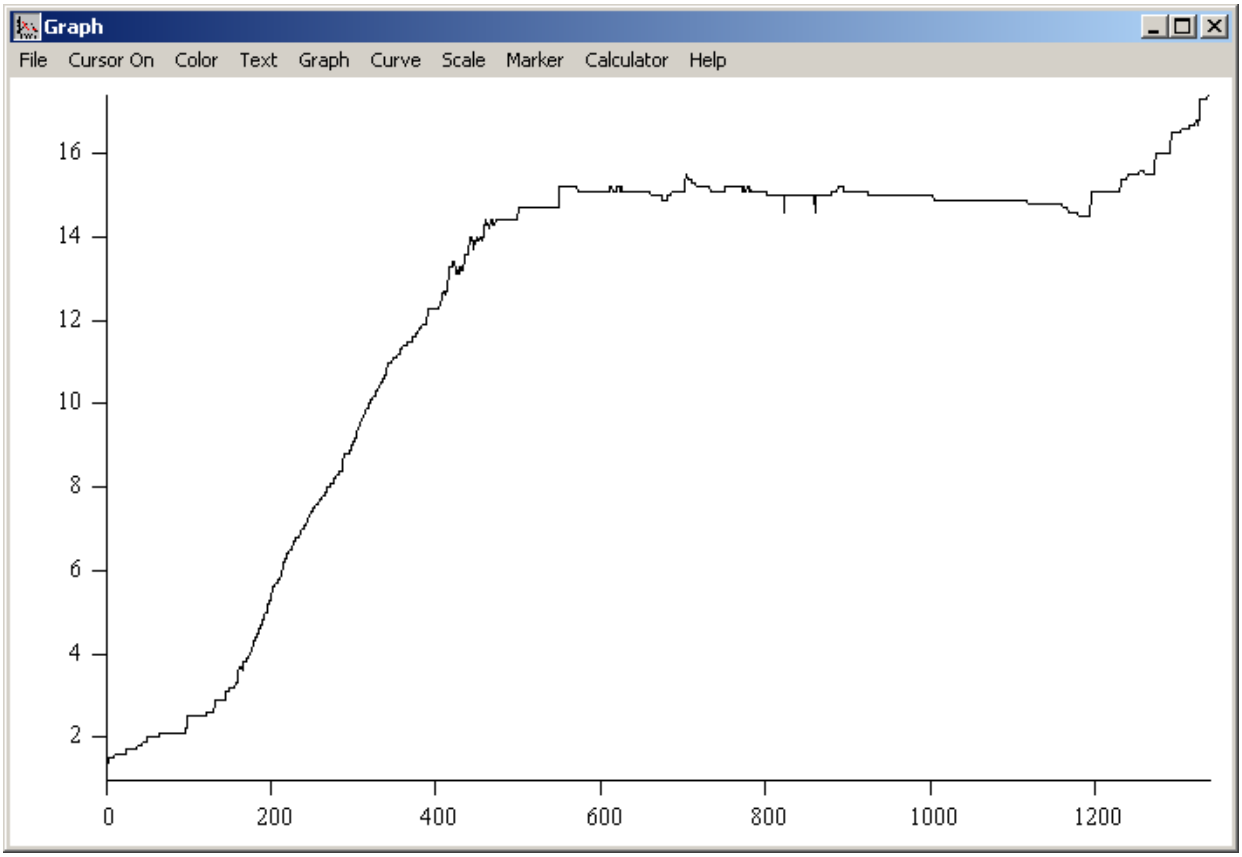

Fig. 3.1-1 *Graph* Window

The window may display several graphs that may contain more than one curve. Besides that, the window may contain text boxes of various sizes (Fig. 3.1-2). Graph objects and text boxes are movable. To select an object to be relocated, the user double-clicks on it. A frame appears around the object. The user can move a frame border, two adjacent borders or a whole frame by dragging, respectively, the border, the corner or the frame area. To remove the frame, the user should double-click on the object or press ***Esc***.

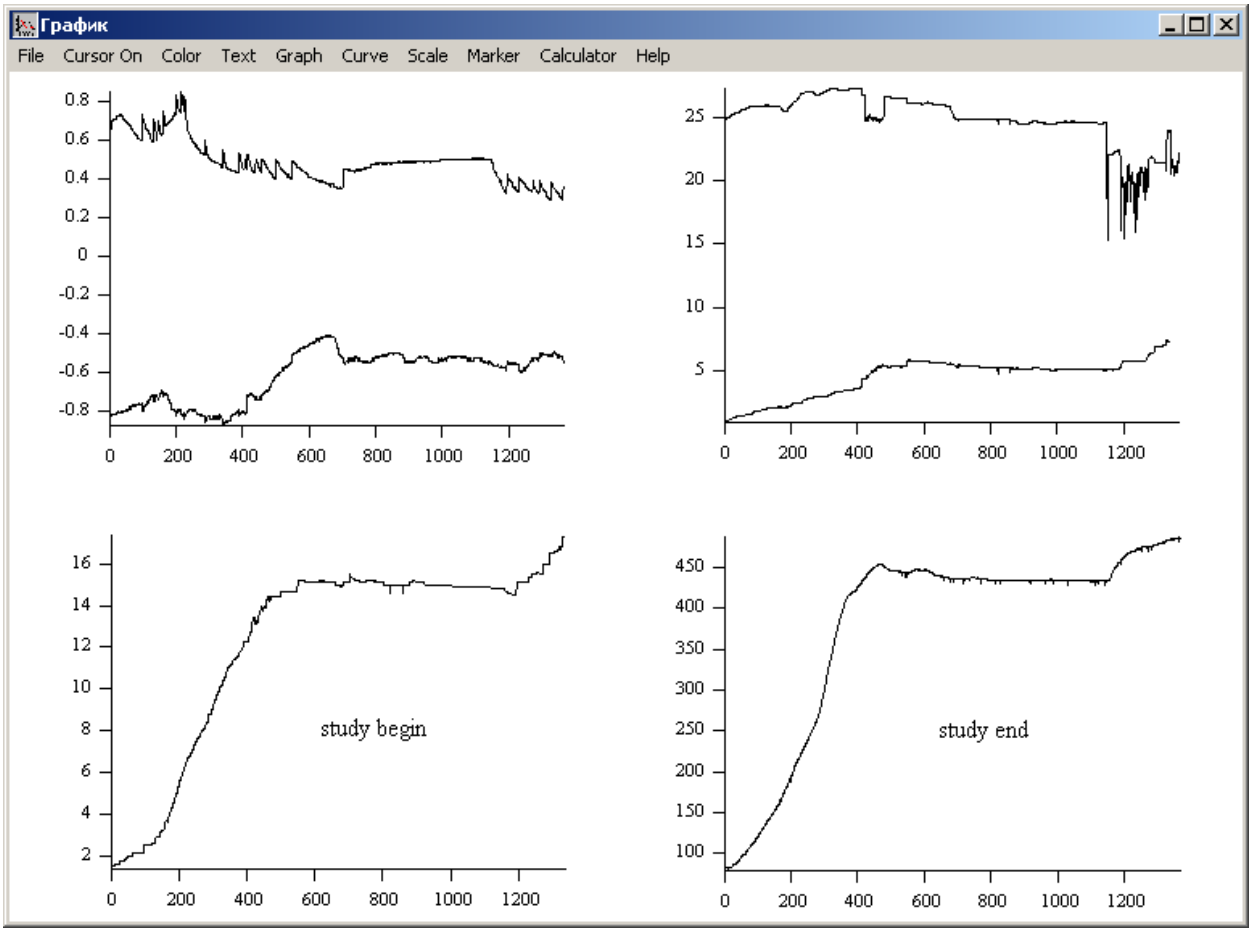

Fig. 3.1-2 *Graph* Window with Four Graphs, Six Curves and Two Comments

Almost all operations in the *Graph* window are conducted through the window menu (Fig. 3.1-3).

File Cursor On Color Text Graph Curve Scale Marker Calculator Help

Fig. 3.1-3 *Graph* Window Menu

3.1.1 File

This menu allows the user to work with the window itself, graphs in the window, curves in the graphs (Fig. 3.1-4).

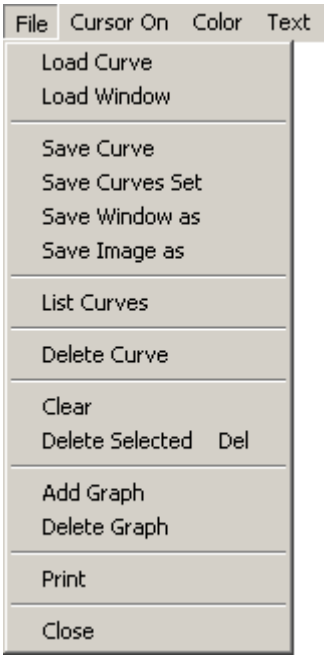

Fig. 3.1-4 *File* Menu

3.1.1.1 Load Curve

Loads a curve from a file in one of the following formats: internal, GIM, text.

If the window displays more than one graph, the *Select Graph* window will open to select the graph for the curve.

3.1.1.2 Load Window

Loads the content of the *Graph* window from a file saved earlier (see *Save Window as*).

3.1.1.3 Save Curve

Saves a curve into a file in one of the following formats: internal, GIM, text.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be saved.

3.1.1.4 Save Curves Set

Saves curves into files in the following formats: internal, GIM, text. Each saving is accompanied by opening of the *Comments* window with comments on the curve. The user can change the comments.

If the window displays more than one curve, the *Select Curve* window will open to select the curves (with the graph numbers) to be saved.

3.1.1.5 Save Window as

Saves the content of the *Graph* window into a file. All graphs, curves and text boxes will be saved, including their positions in the graph.

3.1.1.6 Save Image as

Saves an image in the *Graph* window into a BMP or WMF file.

3.1.1.7 List Curves

Opens the *Select Curve* window (Fig. 3.1-5) with the list of curve files, in the GIM and text formats, located in the current directory. The user can load a curve from a file by double-clicking on it or pressing the *Select* button. The window will not close, allowing for loading several curves. The user can load curves from another directory by selecting *Load* on the menu.

If the window displays more than one graph, the *Select Graph* window will open to select the graph for the curve.

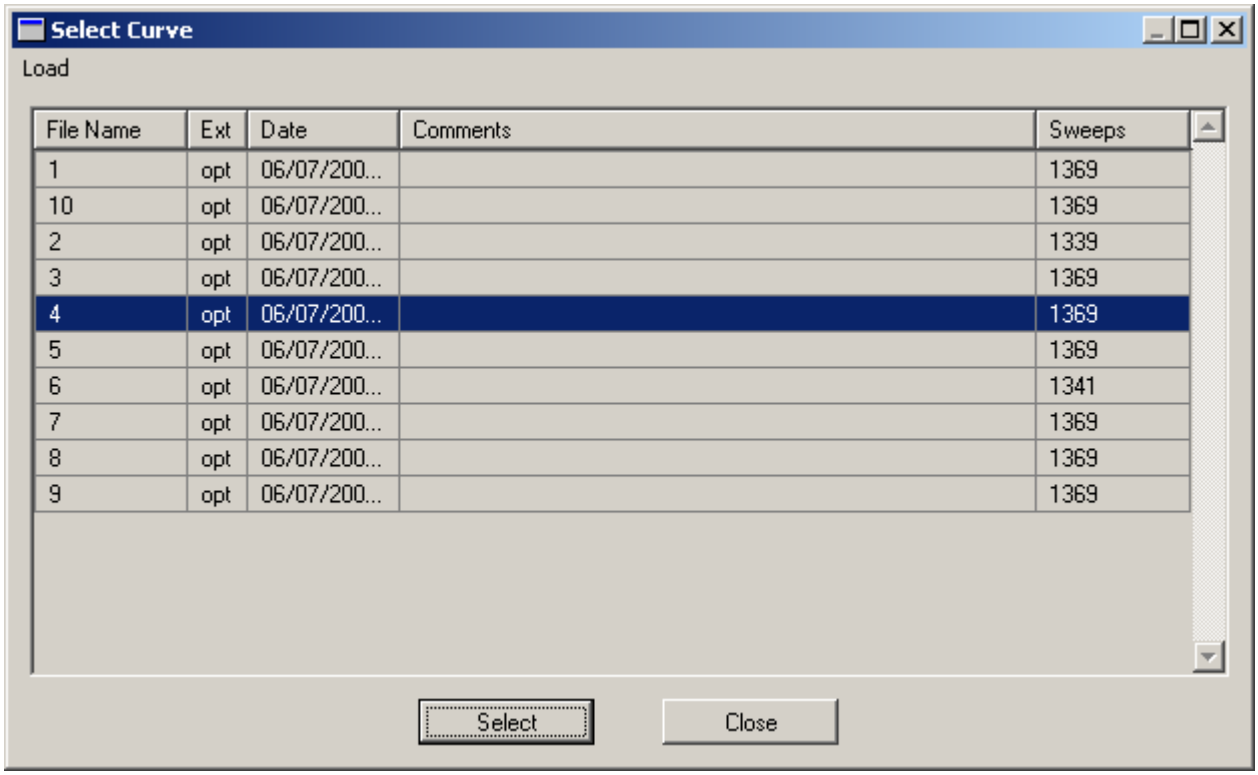

Fig. 3.1-5 *Select Curve* Window for Loading a Curve from the Directory

3.1.1.8 Delete Curve

Deletes a curve.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be deleted.

3.1.1.9 Clear

Deletes all graphs, curves and text.

3.1.1.10 Delete Selected

Deletes the selected graph (with the frame).

Assigned key — ***Del***.

3.1.1.11 Add Graph

Adds a new empty graph. If the total number of graphs (including the added one) does not exceed 6, they will be spread across the screen automatically; otherwise, the new graph will be placed over the others.

3.1.1.12 Delete Graph

Deletes a graph.

If the window displays more than one graph, the *Select Graph* window will open to select the graph to be deleted.

3.1.1.13 Print

The *Print Preview* window (Fig. 3.1-6) opens first. It displays the frame showing the graph layout in the printing area. The user can move a frame border, two adjacent borders or the whole frame in a drag-and-drop mode by clicking, respectively, on the border, the corner or inside the frame.

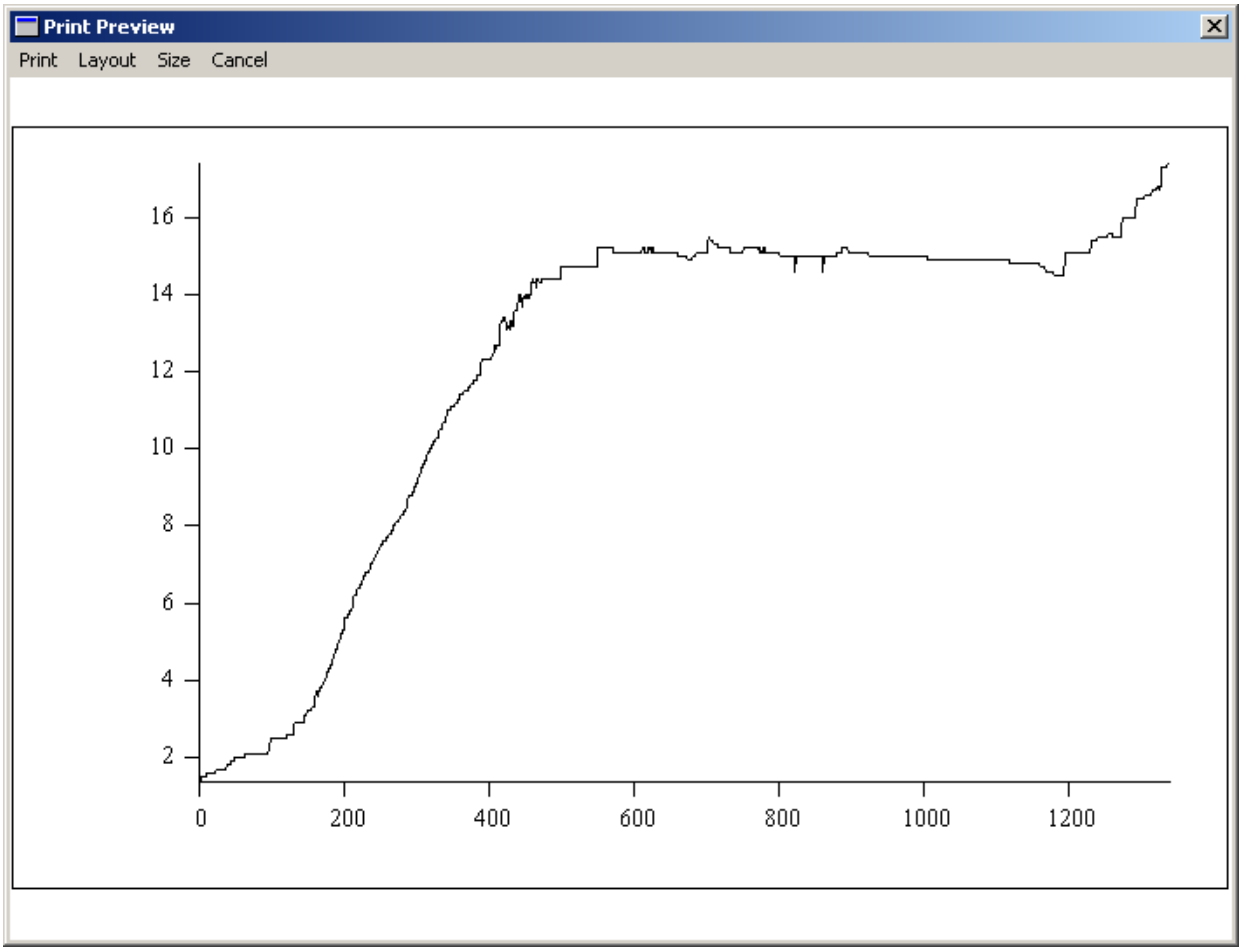

Fig. 3.1-6 *Print Preview* Window for Printing Graphs in A4 Format

The user can select the printing layout on the *Layout* menu: *Landscape* or *Portrait*. Additionally, the user can select an option on the *Size* menu to print the graph on several pages that could be later stapled into a larger page: *A4* — one page (Fig. 3.1-6), *A3* — two pages (Fig. 3.1-7), *A2* — four pages (Fig. 3.1-8), *A1* — eight pages (Fig. 3.1-9), *A0* — sixteen pages (Fig. 3.1-10).

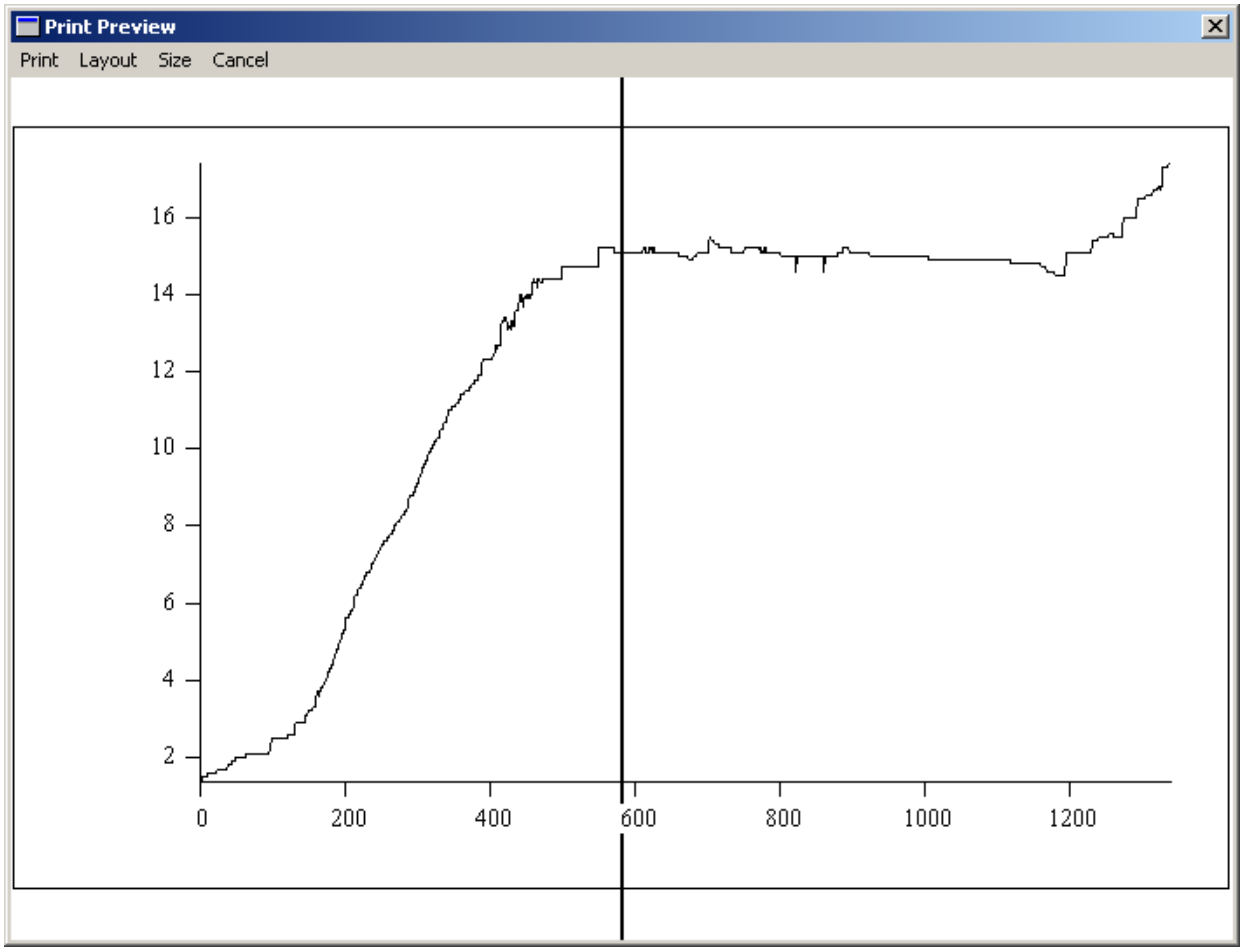

Fig. 3.1-7 *Print Preview* Window for Printing Graphs in A3 Format

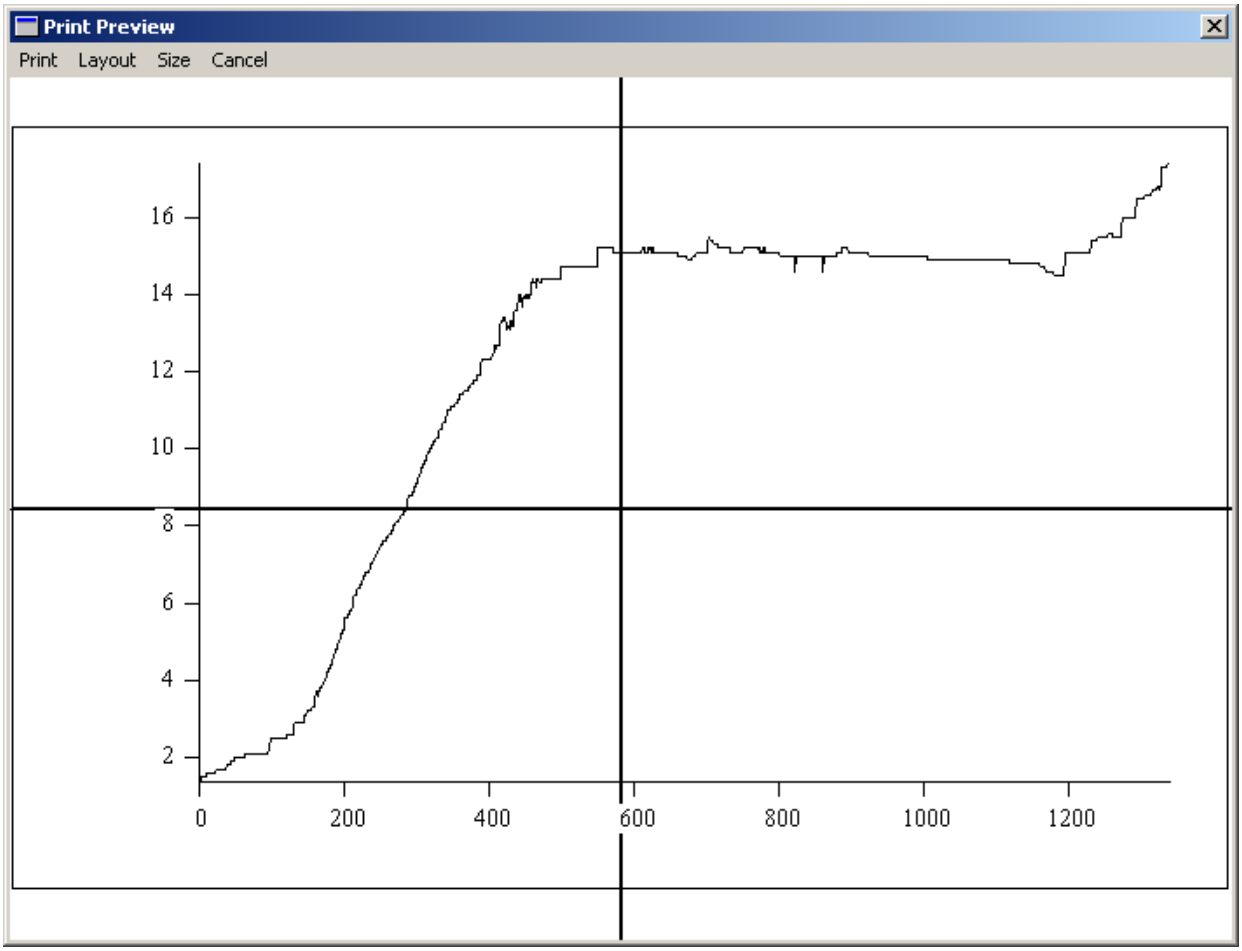

Fig. 3.1-8 *Print Preview* Window for Printing Graphs in A2 Format

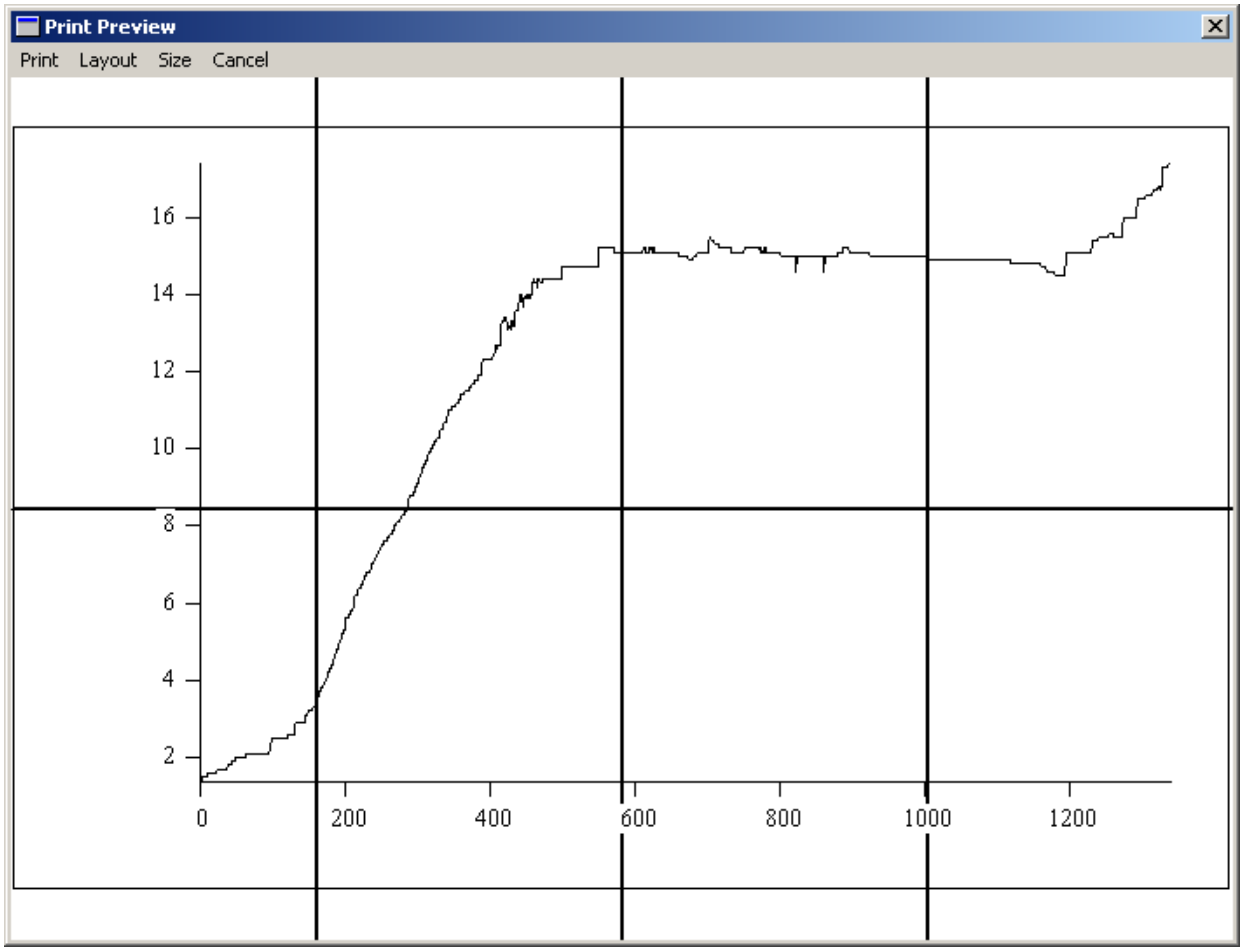

Fig. 3.1-9 *Print Preview* Window for Printing Graphs in A1 Format

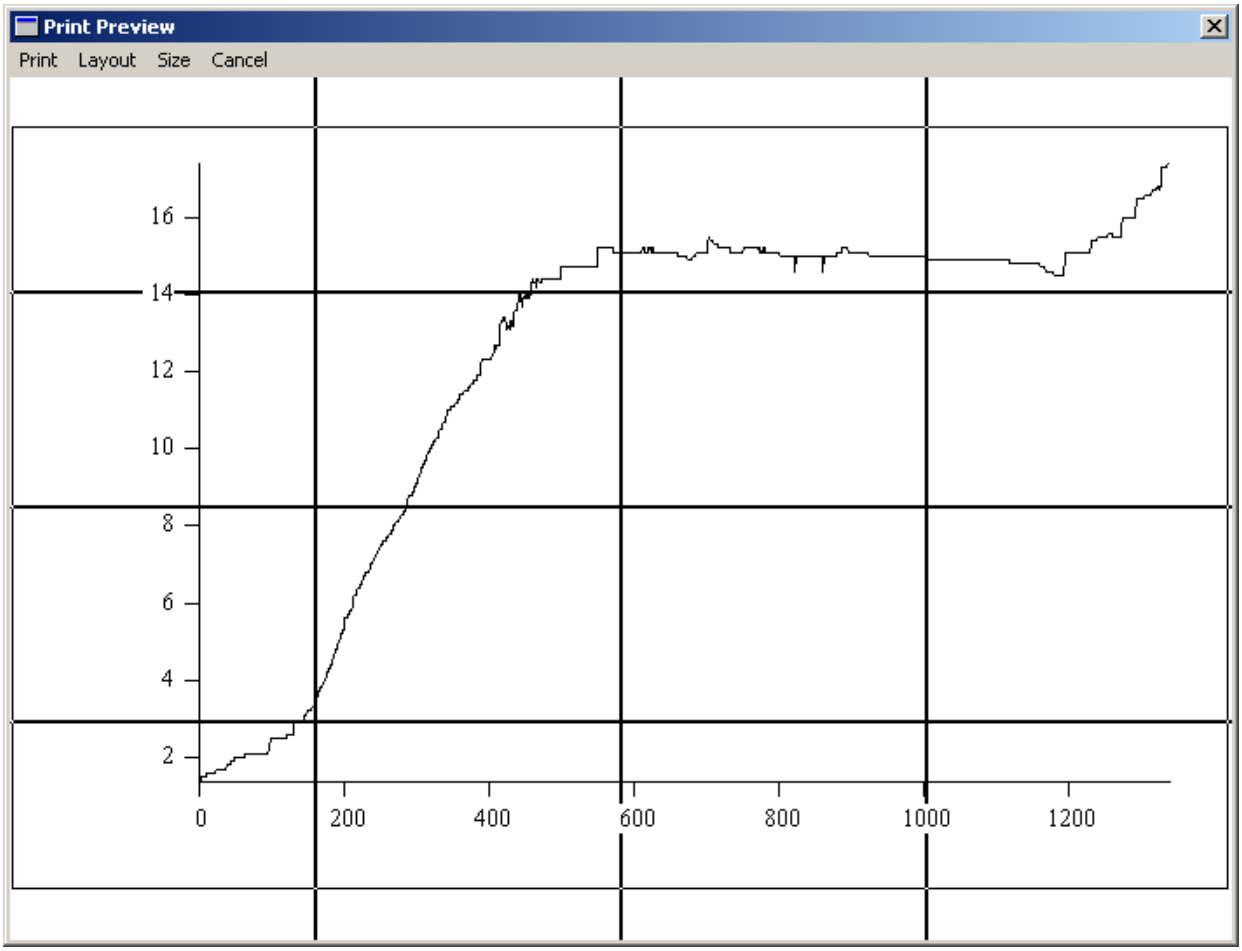

Fig. 3.1-10 *Print Preview* Window for Printing Graphs in A0 Format

3.1.1.14 Close

Closes the window.

3.1.2 Cursor

Toggles the cursor on / off in the *Graph* window.

If toggled on, the cursor is displayed as a vertical line on one of the graphs, and the *X and Y Values* window opens next to the *Graph* window (Fig. 3.1-11).

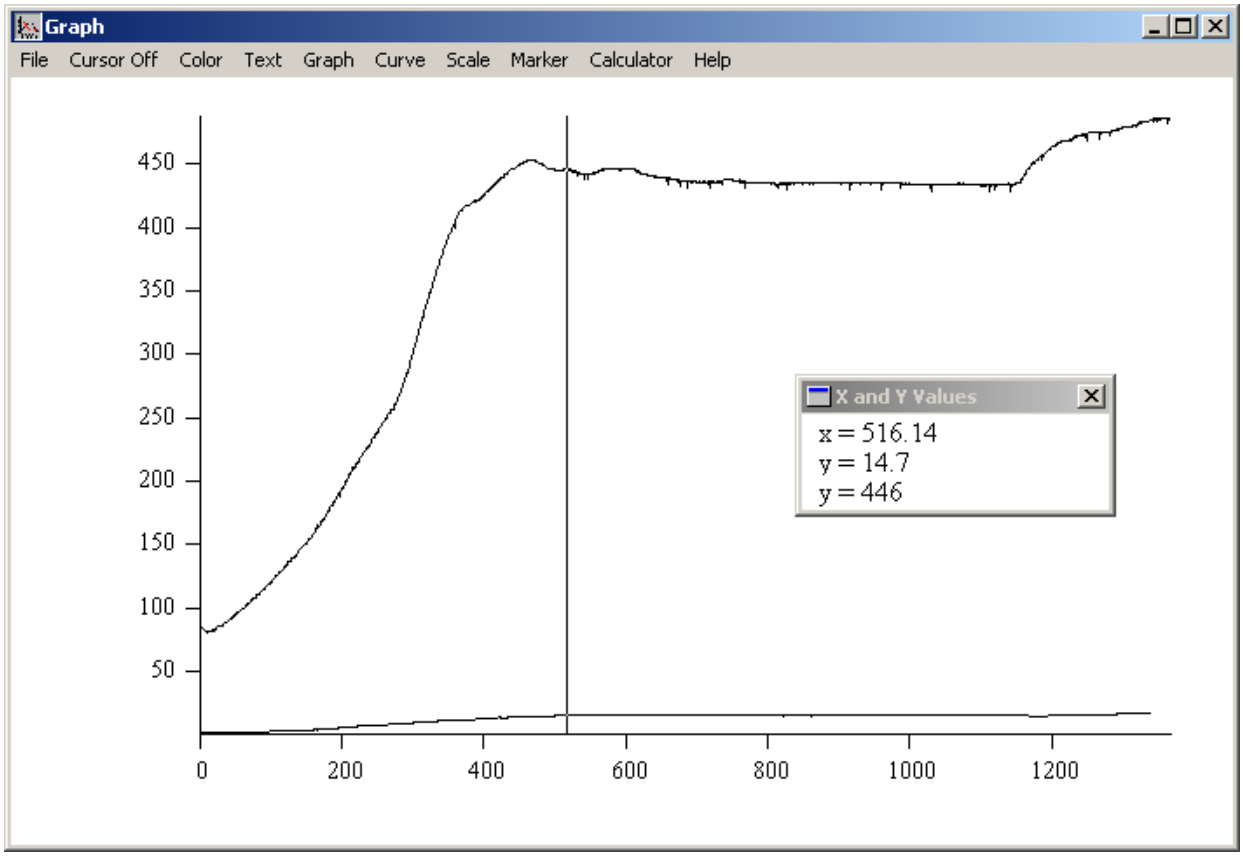

Fig. 3.1-11 The Cursor and *X and Y Values* Window

The *X and Y Values* window displays the *x*-value in the cursor position and *y*-values of the curves in the graph for the given value of *x*. The user can relocate the cursor, as well as move the cursor onto another graph by clicking on the destination point.

3.1.3 Color

This menu allows the user to set up the color of the background, curves and axes (Fig. 3.1-12).

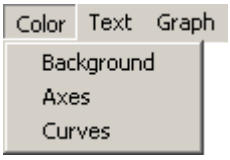

Fig. 3.1-12 *Color* Menu

3.1.3.1 Background

Sets up the color of the background.

3.1.3.2 Axes

Sets up the color of the axes in all graphs.

3.1.3.3 Curves

Sets up the color of a curve.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be painted.

3.1.4 Text

This menu is used for working with text boxes (Fig. 3.1-13).

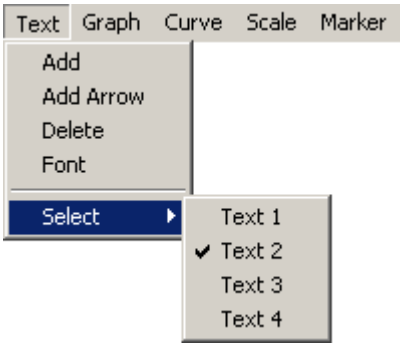

Fig. 3.1-13 *Text* Menu

3.1.4.1 Add

Adds a new text box. First, the user should enter text in the *Enter Text* window. The text will appear at the top left corner of the *Graph* window. Then the text box with the text may be relocated and resized in a drag-and-drop mode.

3.1.4.2 Add Arrow

Adds a special arrow-shaped box. The user can select the type of an arrow in the *Arrowhead* window.

The arrow could be relocated and resized in a drag-and-drop mode (similar to text).

3.1.4.3 Delete

Deletes a text box / arrow

If the window displays more than one text box / arrow, the *Select Curve* window will open to select the object to be deleted.

3.1.4.4 Font

Sets up the font for a text box.

If the window displays more than one text box, the *Select Curve* window will open to select the box to be deleted.

3.1.4.5 Select

Items on this submenu are the existing text boxes / arrows (numbered). A selected item is indicated by a checkmark. The user puts a checkmark against a text box / arrow by clicking on it.

3.1.5 Graph

This menu is used for working with graphs (Fig. 3.1-14).

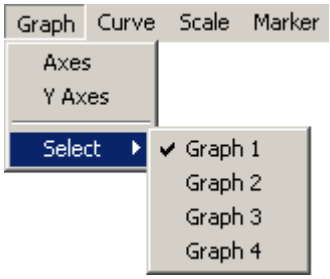

Fig. 3.1-14 *Graph Menu*

3.1.5.1 Axes

Opens the *Axes* window (Fig. 3.1-15) which allows the user to name axes X, Y, Y2 (Y2 is the right vertical axis, see below) and set up the maximum size of the legend font.

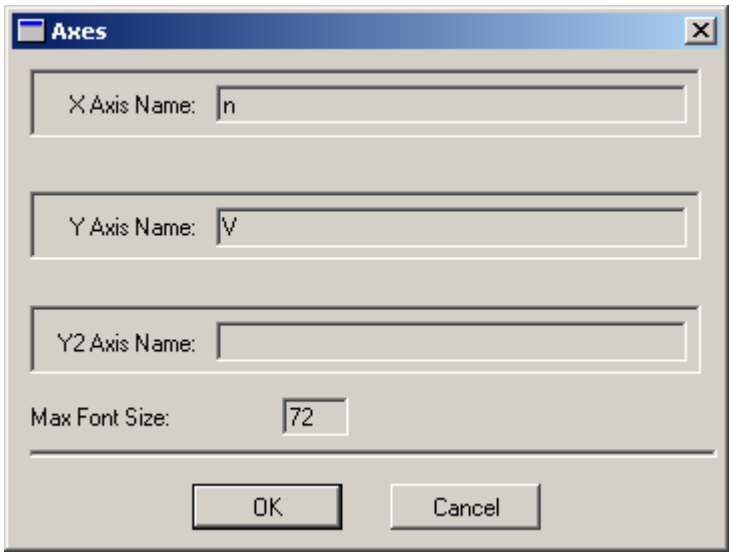

Fig. 3.1-15 *Axes* Window

If the window displays more than one graph, the *Select Graph* window will open to select the graph to be fixed.

3.1.5.2 Y Axes

Opens the *Assign Curves* window (Fig. 3.1-16) allowing the user to assign two Y axes for the graph: on the right and left of the curves. The right Y axis is called the Y2 axis.

If the window displays more than one graph, the *Select Graph* window will open to select the graph to be assigned the Y2 axis.

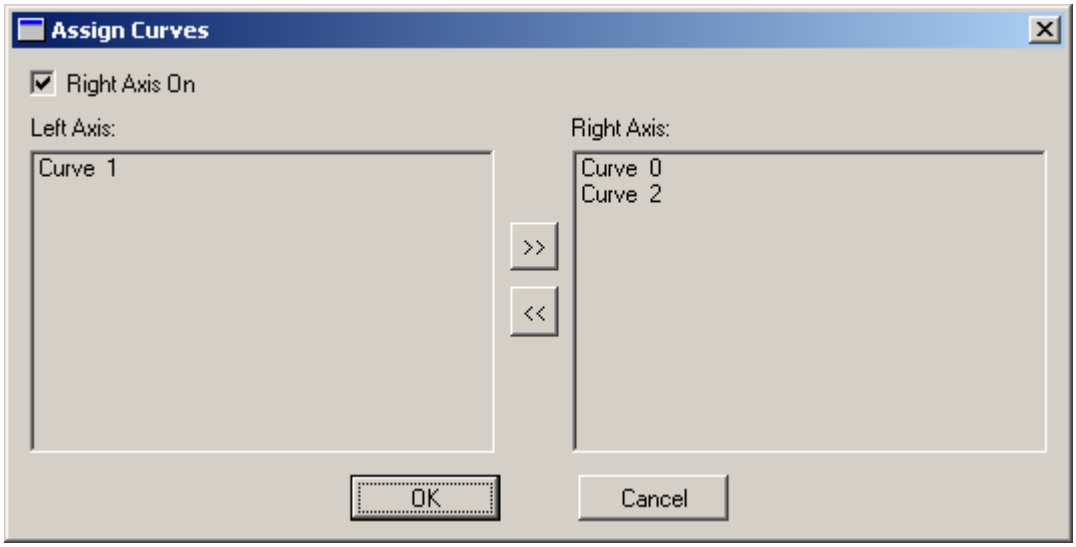

Fig. 3.1-16 *Assign Curves* Window

The Y2 axis is turned on by checking the *Right Axis On* box. To change the ordinate axis for a curve, the user needs to move the curve into the corresponding list with the << and >> buttons.

The assignment of two Y axes makes sense if the axes are scaled differently (Fig. 3.1-17).

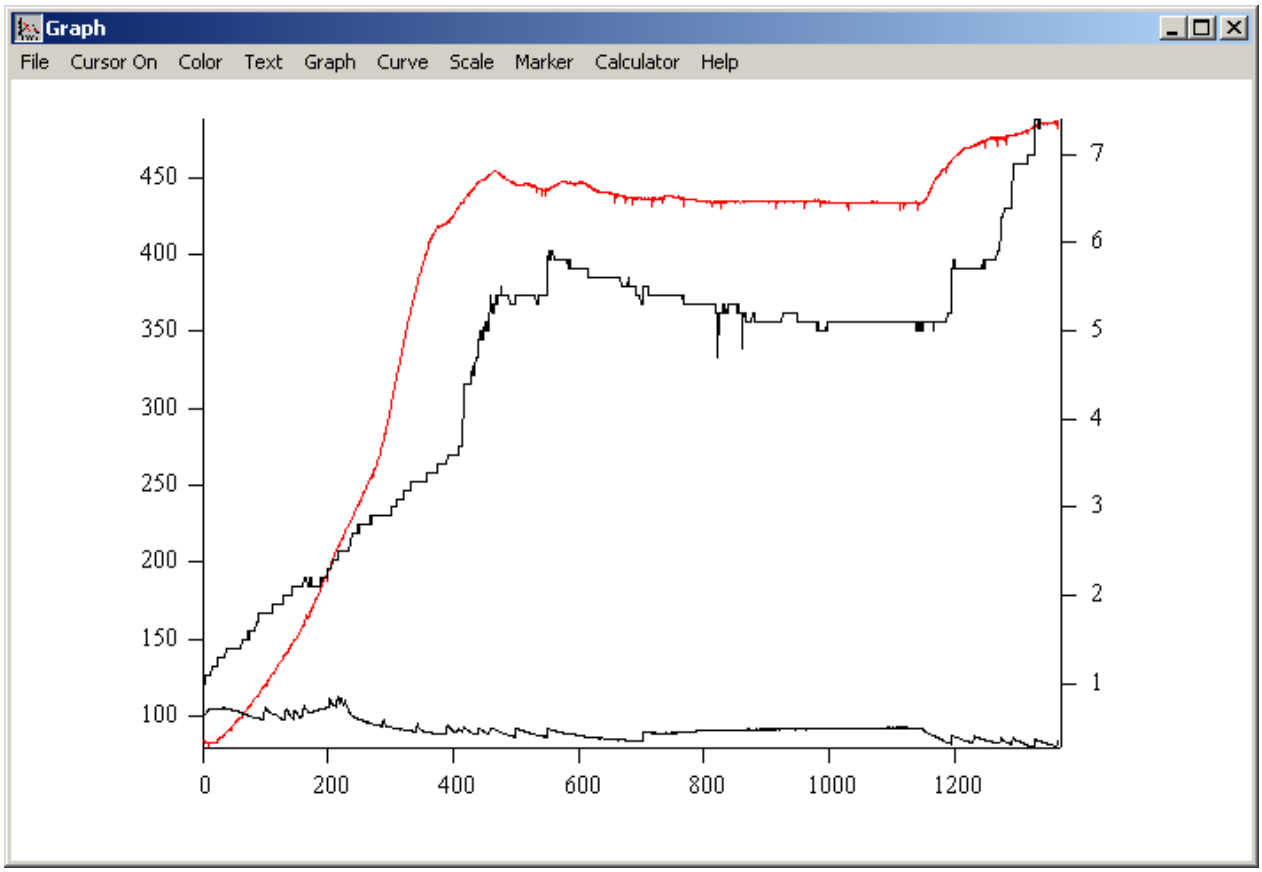

Fig. 3.1-17 The *Graph* Window with Three Curves: Red Curve Uses the Left Y Axis; Black Curves the Right Y Axis

3.1.5.3 Select

Items on this submenu are the existing graphs (numbered). A selected item is indicated by a checkmark. The user puts a checkmark against a graph by clicking on it.

3.1.6 Curve

This menu is used for working with curves (Fig. 3.1-18).

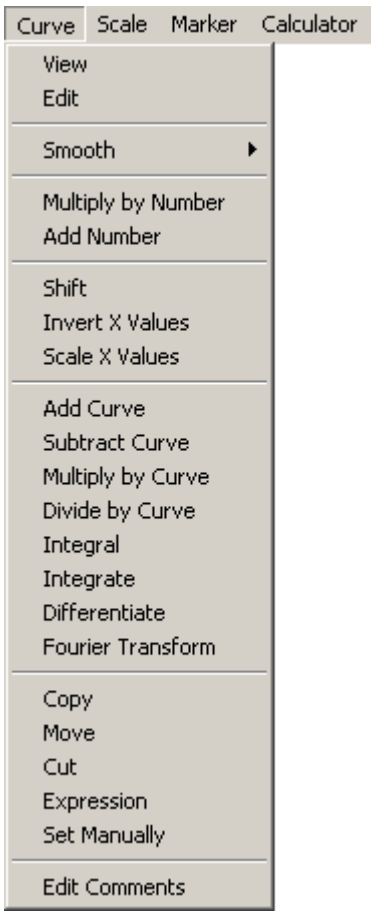

Fig. 3.1-18 *Curve* Menu

3.1.6.1 View

Allows viewing a Pluk-object, representing a curve, in the value browsing window (see Pluk IDE User Guide).

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be viewed.

3.1.6.2 Edit

Opens the *Edit Curve* window for the user (Fig. 3.1-19) to edit the number of points, their X and Y values and comments on a curve.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be edited.

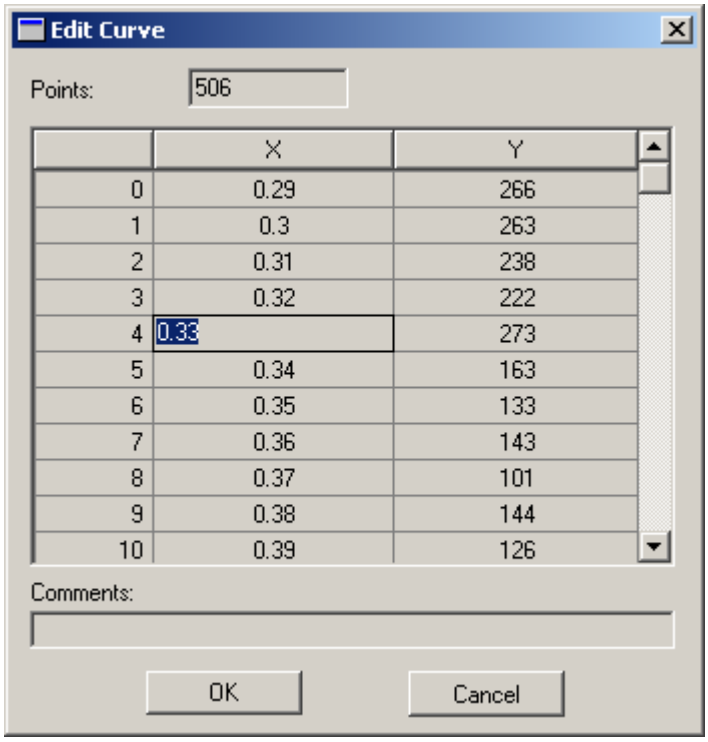

Fig. 3.1-19 *Edit Curve* Window

In table form the window displays the numbers and the X and Y values of the points. The user can edit these values (Fig. 3.1-19). Besides that, the user can add / remove a point by invoking a right-click menu (Fig. 3.1-20) in the table.

Fig. 3.1-20 The Right-click Menu in the *Edit Curve* Window

The *Insert* item inserts a point before a selected point. It is the bisecting point of the segment between the selected and preceding points. *Add* adds a replica of the last point in the table (below). *Remove* deletes a selected point.

If the user increases the number in the *Points* field, additional replicas of the last point will be added at the end of the table. If this number is decreased, the points at the end of the curve will be deleted. The user can change comments in the *Comments* field.

3.1.6.3 Smooth

This menu allows the user to smooth a curve by a number methods (Fig. 3.1-21).

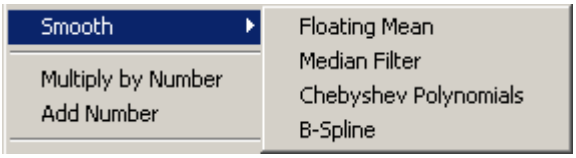

Fig. 3.1-21 *Smooth* Menu

3.1.6.3.1 Floating Mean

Allows the user to smooth a curve by means of the floating mean filter. The *Smooth Curve* window opens before applying the method (Fig. 3.1-22). The user sets up the aperture width, the segment to be smoothed (no smoothing will occur outside the segment) and the segment measurement units (points or X axis units). Then she selects a color for the processed curve on the graph.

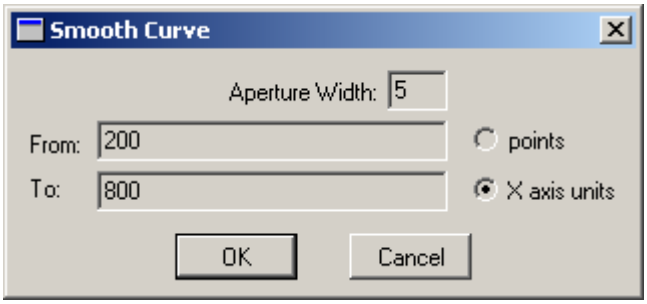

Fig. 3.1-22 *Smooth Curve* Window

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.3.2 Median Filter

Allows the user to smooth a curve by means of the median filter.

The operation is the same as *Floating Mean*.

3.1.6.3.3 Chebyshev Polynomials

Allows the user to smooth a curve by means of the method of approximation by a linear combination of Chebyshev polynomials (from 0 to a specified degree). Often this method gives better results than the floating mean or median filters.

The operation is the same as *Floating Mean*, but instead of the aperture width, the user specifies the maximum degree of polynomials (Fig. 3.1-22).

3.1.6.3.4 B-Spline

Allows the user to smooth a curve by means of the method of approximation by a B-spline — a smooth curve drawn through some points of the original curve (anchor points). Often this method gives better results than the floating mean or median filters.

The operation is the same as *Floating Mean*, but instead of the aperture width, the user specifies the number of anchor points (Fig. 3.1-22).

3.1.6.4 Multiply by Number

Allows multiplying a curve by a number specified by the user.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.5 Add Number

Allows adding to a curve a number specified by the user.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.6 Shift

Allows shifting a curve along the X axis at a distance specified by the user.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.7 Invert X Values

Allows applying a reciprocal function to the X values of the points (all the values must be either greater than zero or less than zero). The user selects a color for the processed curve on the graph.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.8 Scale X Values

Allows multiplying the X values of the curve by a number specified by the user, i.e. the user can compress / stretch the curve along the X axis. The user selects a color for the processed curve on the graph.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.9 Add Curve

Allows adding two curves. In the *Add Curve* window (Fig. 3.1-23), the user should specify two operand-curves, the graph to insert the result into, and give comments on the resulting curve. The user selects a color for the processed curve on the graph.

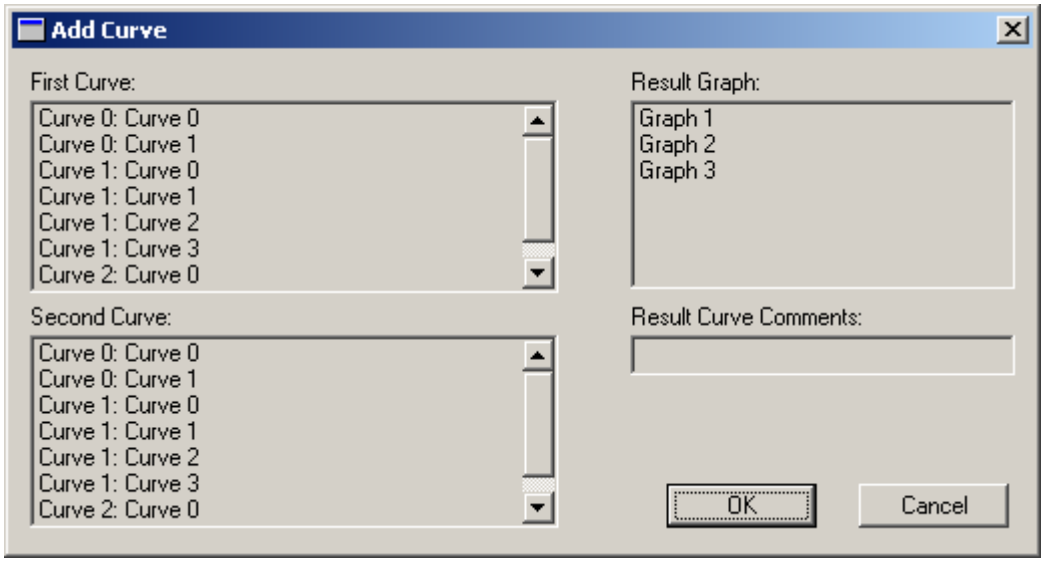

Fig. 3.1-23 *Add Curve* Window

3.1.6.10 Subtract Curve

Allows subtracting one curve from another. The operation is the same as *Add Curve.*

3.1.6.11 Multiply by Curve

Allows multiplying two curves. The operation is the same as *Add Curve*.

3.1.6.12 Divide by Curve

Allows dividing one curve by another. The operation is the same as *Add Curve*.

3.1.6.13 Integral

Allows integrating a curve in an interval indicated by the user. The result is a number.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.14 Integrate

Allows integrating a curve. The resulting graph represents an integral of the curve **f(*x*)** from the beginning of the curve to ***x***. The user selects a color for the processed curve on the graph.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.15 Differentiate

Allows differentiating a curve. The resulting graph represents a derivative of the curve. The user selects a color for the processed curve on the graph.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be processed.

3.1.6.16 Fourier Transform

Allows applying a direct or inverse Fourier transform. The procedure begins with the opening of the *Fourier Transform* window (Fig. 3.1-24) to specify the segment to be transformed and its measurement units (points or X axis units). If *New Graph* is checked, a new graph with the transform result will be created. If *New Graph* is unchecked and the window displays more than one graph, the *Select Graph* window will open to select the graph that will display the transform result. If *Fourier Inversion* is unchecked, the direct Fourier transform will be applied, if checked — the inverse Fourier transform. In the case of direct transform, the user must select the curve that will be the real part of the original complex function (the imaginary part equals 0 by default). In the case of inverse transform, the user must select the real-part curve and then the imaginary-part curve. The procedure of either transformation gives two curves: the real and imaginary part of the resulting complex function.

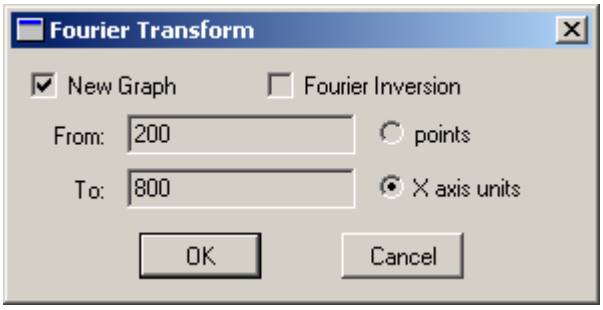

Fig. 3.1-24 *Fourier Transform* Window

3.1.6.17 Copy

Allows the user to make a copy of a curve in the original or another graph.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be copied. If the window displays more than one graph, the *Select Graph* window will open to select the graph to put the curve into.

3.1.6.18 Move

Moves a curve to another graph.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be moved. If the window displays more than one graph, the *Select Graph* window will open to select the graph to put the curve into.

3.1.6.19 Cut

Cuts a segment that could be placed in another graph. The user sets up the segment length and color.

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to be cut. If the window displays more than one graph, the *Select Graph* window will open to select the graph to put the cutout into.

3.1.6.20 Expression

Allows the user to get a new curve resulting from the computation of an arbitrary expression that includes curves as operands. The user enters the expression in Pluk Language (see Pluk Language Reference Book). In the expression the curve is denoted by **Y[i][j]**, where **i** — graph number, **j** — curve number (the numbers start from 0). For example, the expression **Y[0][0] * 10 – Y[0][1] ** 2 * Y[1][0]** means: the first curve in the first graph is multiplied by 10, from which result the squared product of the second curve in the first graph and the first curve in the second graph is subtracted. The user selects a color for the curve created on the graph.

If the window displays more than one graph, the *Select Graph* window will open to select the graph to put the curve into.

3.1.6.21 Set Manually

Allows the user to create a new curve by entering its values manually. The *Edit Curve* window (Fig. 3.1-19) opens for the user to edit the number of points, their X and Y values and comments on the curve (see *Edit*). The user selects a color for the curve created on the graph.

If the window displays more than one graph, the *Select Graph* window will open to select the graph to put the curve into.

3.1.6.22 Edit Comments

Allows the user to edit comments on the curve.

3.1.7 Scale

This menu allows the user to set up the axes scales, legend and divisions on the axes (Fig. 3.1-25).

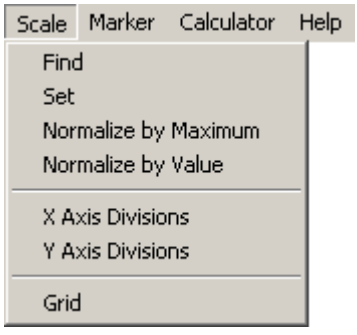

Fig. 3.1-25 *Scale* Menu

3.1.7.1 Find

Some operations with curves, e.g. arithmetic, may give results that will not fit within the graph bounds. This item recalculates the scales in all graphs to allow all curves to be fully displayed.

3.1.7.2 Set

Opens the *Set Graph Scale* window (Fig. 3.1-26). The range for the X axis is set in the *X min* and *X max* fields, for the Y axis — *Y min* and *Y max*, for the Y2 axis (if specified) — *Y2 min* and *Y2 max*. If *X-Log* is unchecked, the X axis is linear, if checked — logarithmic. The same holds for the Y (*Y-Log*) and Y2 (*Y2-Log*) axes.

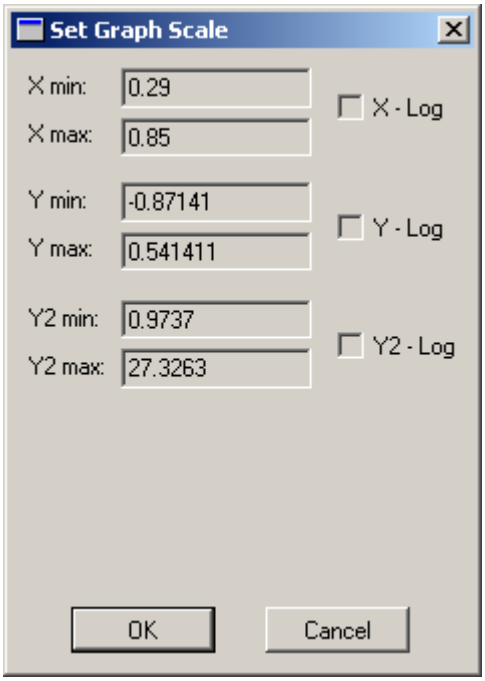

Fig. 3.1-26 *Set Graph Scale* Window

If the window displays more than one graph, the *Select Graph* window will open to select the graph to set the scale for.

Note that the user can enlarge a rectangular area on the graph to the size of the graph. She selects the area by dragging the mouse pointer between two diagonal corners. To restore the original scale, the user must select *Find* on the menu.

3.1.7.3 Normalize by Maximum

Divides each curve of a graph by its maximum value.

If the window displays more than one graph, the *Select Graph* window will open to select the graph to be normalized. If the graph has two Y axes, the *Select Axis* window will open to select the axis: the curves tied to this axis will be normalized.

3.1.7.4 Normalize by Value

Divides each curve of a graph by its value in the point specified by the user.

If the window displays more than one graph, the *Select Graph* window will open to select the graph to be normalized.

3.1.7.5 X Axis Divisions

Opens the *Axis Divisions* window (Fig 3.1-27).

If *Auto* is checked, the user is not allowed to play with axis divisions. If this box is unchecked, the user can:

- set major divisions (possibly numbered) either in a specified range and with a specified increment or by entering exact values separated with commas;
- set minor divisions (not numbered) in each major one as either one common figure (the number of minor divisions in each major) or a set of figures separated with commas (the major divisions specified above will contain different number of minor divisions).

If *Show Legend* is unchecked, major divisions on the axis are not numbered.

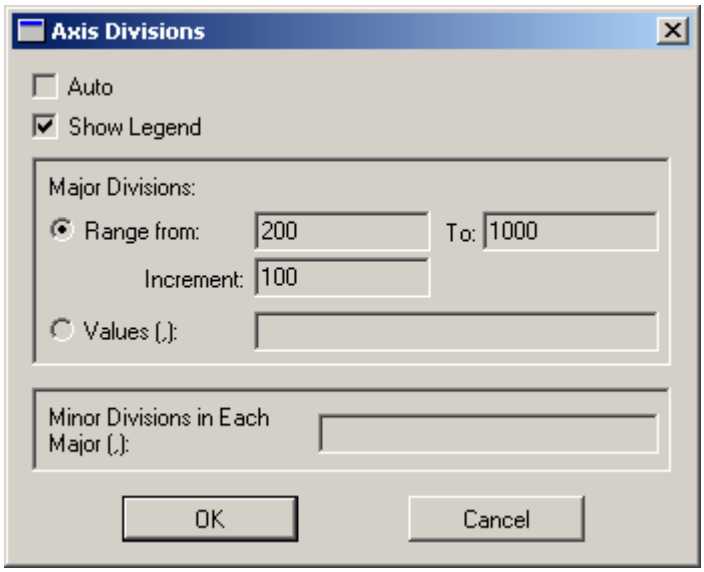

Fig 3.1-27 *Axis Divisions* Window

3.1.7.6 Y Axis Divisions

Is similar to *X Axis Divisions*, save that the *Axis Division* window (Fig 3.1-27) may contain the *Right Axis* checkbox.

3.1.7.7 Grid

If the box is checked, all graphs display a grid drawn through major divisions on the X and Y axes.

3.1.8 Marker

This menu is used for setting up the appearance of a curve, the width of the axes and the size of the legend (Fig. 3.1-28).

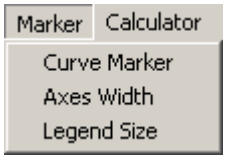

Fig. 3.1-28 *Marker* Menu

3.1.8.1 Curve Marker

Opens the *Select Marker* window (Fig. 3.1-29).

If *Line* is selected on the *Type* list, the curve is drawn as a line; otherwise the curve is drawn with a selected shape. The user sets the line width or the shape size in the *Size* box. If the type of a selected shape is *Line*, the type of the line is specified in the *Attribute* list (e.g. *Dotted*).

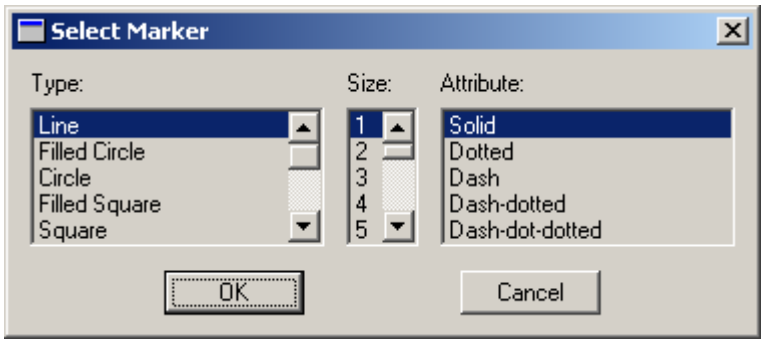

Fig. 3.1-29 *Select Marker* Window

If the window displays more than one curve, the *Select Curve* window will open to select the curve (with the graph number) to set the appearance for.

3.1.8.2 Axes Width

Sets up the width of a graph axes.

If the window displays more than one graph, the *Select Graph* window will open to select the graph.

3.1.8.3 Legend Size

Specifies the portion in the graph area allotted for the legend (numbers, divisions, axes labels). This implies the maximum dimensions of the legend. The real size may be smaller if the user selects a fairly small font size in the *Axes* window (see 3.1.5.1).

If the window displays more than one graph, the *Select Graph* window will open to select the graph.

3.1.9 Calculator

Opens the *Calculator* window. The window is used for computation of standard expressions written in Pluk Language (see Pluk Language Reference Book). The user may use numerical constants in expressions, constant **PI** (denoting π), functions **Sin**, **Cos**, **Exp**, **Ln** (natural logarithm), **Lg** (common logarithm), **Log(n, m)** (logarithm **m** to the base **n**), etc (see Standard Library Reference Book).

3.1.10 Help

Opens Graph Analyzer User Guide (same as 3).

3.1.11 Right-click Menu

Right-clicking in the *Graph* window opens the popup menu, duplicating most frequently used items on the main menu (Fig. 3.1-30).

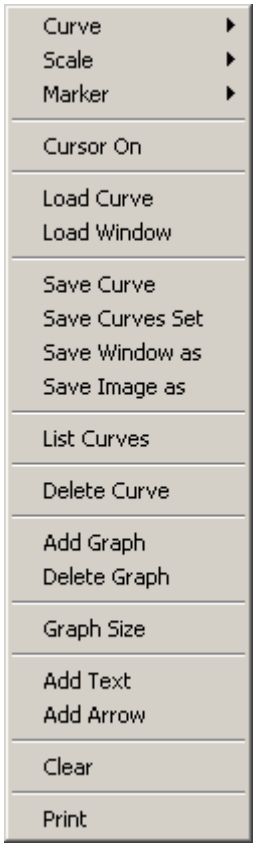

Fig. 3.1-30 Right-click Menu in the *Graph* Window

3.1.11.1 Curve

See 0.

3.1.11.2 Scale

See 3.1.7.

3.1.11.3 Marker

See 3.1.8.

3.1.11.4 Cursor

See 3.1.2.

3.1.11.5 Load Curve

See 3.1.1.1.

3.1.11.6 Load Window

See 3.1.1.2.

3.1.11.7 Save Curve

See 3.1.1.3.

3.1.11.8 Save Curves Set

See 3.1.1.4.

3.1.11.9 Save Window as

See 3.1.1.5.

3.1.11.10 Save Image as

See 3.1.1.6.

3.1.11.11 List Curves

See 3.1.1.7.

3.1.11.12 Delete Curve

See 3.1.1.8.

3.1.11.13 Add Graph

See 3.1.1.11.

3.1.11.14 Delete Graph

See 3.1.1.12.

3.1.11.15 Graph Size

Sets the graph size in proportion to the window size.

3.1.11.16 Add Text

See 3.1.4.1.

3.1.11.17 Add Arrow

See 3.1.4.2.

3.1.11.18 Clear

See 3.1.1.9.

3.1.11.19 Print

See 3.1.1.13.