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SEGYTools

OPERATION MANUAL

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TECHNICAL SUPPORT
Support for licensed users on any topics covered in this manual and for the use of the software described herein may be obtained from:

Email: support@fgps.com

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1 OVERVIEW

SEGYTools is a Microsoft Windows based software program which provides the user with quality control functions and utilities, including first break picking, for datasets recorded in the SEG-Y format.

The installation and licensing of this program is documented separately from this manual.

Numeric data must be recorded in “big endian” byte order.

File formats currently supported are:

- SEG-Y Revision 1
- CGG STG1

Data sample formats currently supported are:

- 4 byte IBM floating point
- 4 byte IEEE floating point

2 PROJECT

To create a new project select *File* | *New Project* from the main menu, and enter a name for the project.

To open an existing project select *File* | *Open Project* from the main menu.

To save a project select *File* | *Save Project* or *File* | *Save Project As* from the main menu. All parameters and settings are saved.

3 SETUP

For the basic program setup the following actions should be carried out:

1. From the main menu go to *File* | *New Project*, enter a project name.
2. Enter, or browse for, the SEGY data file. As soon as this is done the text and binary headers and first few trace headers and data are read.
3. It is recommended to review the trace header fields and edit them if required. See section 6.

3.1 Sample Format

The sample format specified in the binary header may be overridden by selecting the format from the dropdown list.

3.2 Record Length

Optionally set the record length. This is provided to accelerate data reading and display if it is not required to display the full record length e.g. if only the near offsets are required for first break picking.

3.3 Trace Annotation

Optionally select from the *Trace Annotation* list the trace header fields to be displayed along the trace axis of the trace plot. These would typically be shotpoint receiver line and point number. Note that these fields may have to be manually defined (see sections 6.1 and 6.2).

A maximum of 6 trace annotation fields may be specified.

The trace annotation data are also displayed in the Trace Attribute window.

When the Trace Header is edited and saved the annotation settings are reset and need to be re-selected.

3.4 Trace Plot

Specify the trace and fill colour by clicking on the colour squares.

Specify the colours used for plotting computed first break picks and imported first break picks.

3.5 Trace Sorting

A maximum of 10 sort criteria may be specified. Each sort criterion is specified by clicking on the rid and selecting the criterion from the dropdown list. Click the *Apply Changes* button for the changes to take effect if sorting is enabled.

To enable sorting the *Use trace sorting* checkbox must be checked.

Note: For trace sorting all trace headers must be read. This will take place when sorting is enabled for the first time if all trace headers have not already been read. ***Reading all trace headers may take several minutes***.

4 TEXT HEADER

The program automatically detects the text header format (ascii or ebsidic) and displays it in the *Text Header* page. If extended headers are present these are appended to the text header display.

On the text header click the right mouse button for a popup menu providing basic editing functions.

The information in the text header is conventionally used to manually define trace header fields.

5 BINARY HEADER

The *Binary Header* page displays a table of the binary header information. This is for information only and cannot be edited.

6 TRACE HEADER

The trace header fields initially displayed are the standard fields defined in the SEGY format release 1.0, May 2002.

Four columns of information are displayed:

Description:	The field description
Byte:	The position in the trace header of the first byte of the field
Type:	The numeric format of the field – see 6.3 below.
Operation:	Optional operation – see 6.4 below.
Value:	The value of the field for the selected trace.

The trace header for the selected trace number, initially trace 1, is displayed. The trace number for which values are displayed can be changed by either typing in the number in the *Trace Number* field, or by holding down the left or right arrow buttons.

6.1 Editing Fields

Trace header fields, apart from *Value* can be edited by overtyping the existing values. This may be necessary in order to apply the byte locations defined in the text header, or to abbreviate the description of a field which is used for annotating the trace plot (see Trace Annotation under section 2).

To edit a field:

1. Double click on the field or press <F2>.
2. After making all the necessary edits to one or more fields click the *Apply Edits* button.

To undo edits *before* the *Apply Edits* button has been clicked, click the *Undo Edits* button.

Changes to the trace header fields will be preserved when the project is saved.

6.2 Adding and Deleting Fields

New fields can be added so as to include additional fields defined in the text header. A maximum of 100 fields in total are allowed. To add a field:

1. Click the *New Field* button.
2. Enter the fields attributes.
3. Click the *Apply Edits* button.

To delete a field click on the field then click the *Delete Field* button.

Additions to the trace header fields will be preserved when the project is saved.

6.3 Field Type

The field types supported are:

INT2:	2 byte integer
INT4:	4 byte integer
*FP 4b*10^2b:*	6 byte field. Bytes 1-4 (4 byte integer) is multiplied by 10 to the power of bytes 5-6 (2 byte integer), as defined in the SEG-Y format.
IBM FP4:	IBM 4 byte floating point.

6.4 Field Operation

Depending on how the trace header has been written it may be required to modify the value written in order to extract the required value, or to correct the value. Two types of operation are supported: arithmetic and mask. The resultant value appears after the *Apply Edits* button is clicked.

6.4.1 Arithmetic Operation

The four basic functions are supported and are symbolised as follows:

+	add
-	subtract
*	multiply
/	divide

Each operation is performed sequentially, i.e. rules of precedence do not apply.

For example, the operation "`+1-2/3.1*4.5`" when applied to a trace header value of `10` will yield:

```
+1 = 11
-2 = 9
/3.1 = 2.9032258
*4.5 = 13.064516
```

6.4.2 Mask Operation

A mask is used to select a specific part of a field only. The mask symbol for each digit to be used is a hash (#). The mask can apply only for adjacent digits.

For example, a line number and point number may have been written to the trace header combined in a single field as an eight digit integer, `12345678`, where the line number is `1234` and the point number is `5678`.

The mask to yield only the line number would be: `"####"  = 1234`
The mask to yield only the point number would be: `"  ####" = 5678`

7 TRACE DATA

The *Trace Data* page displays the raw and filtered sample data for the currently selected trace. The trace number for which values are displayed can be changed by either typing in the number in the *Trace Number* field, or by holding down the left or right arrow buttons.

8 PLOT

The trace plot controls are divided into several parameter groups described below.

The trace annotation displayed at the top is selectable from the *Setup* page.

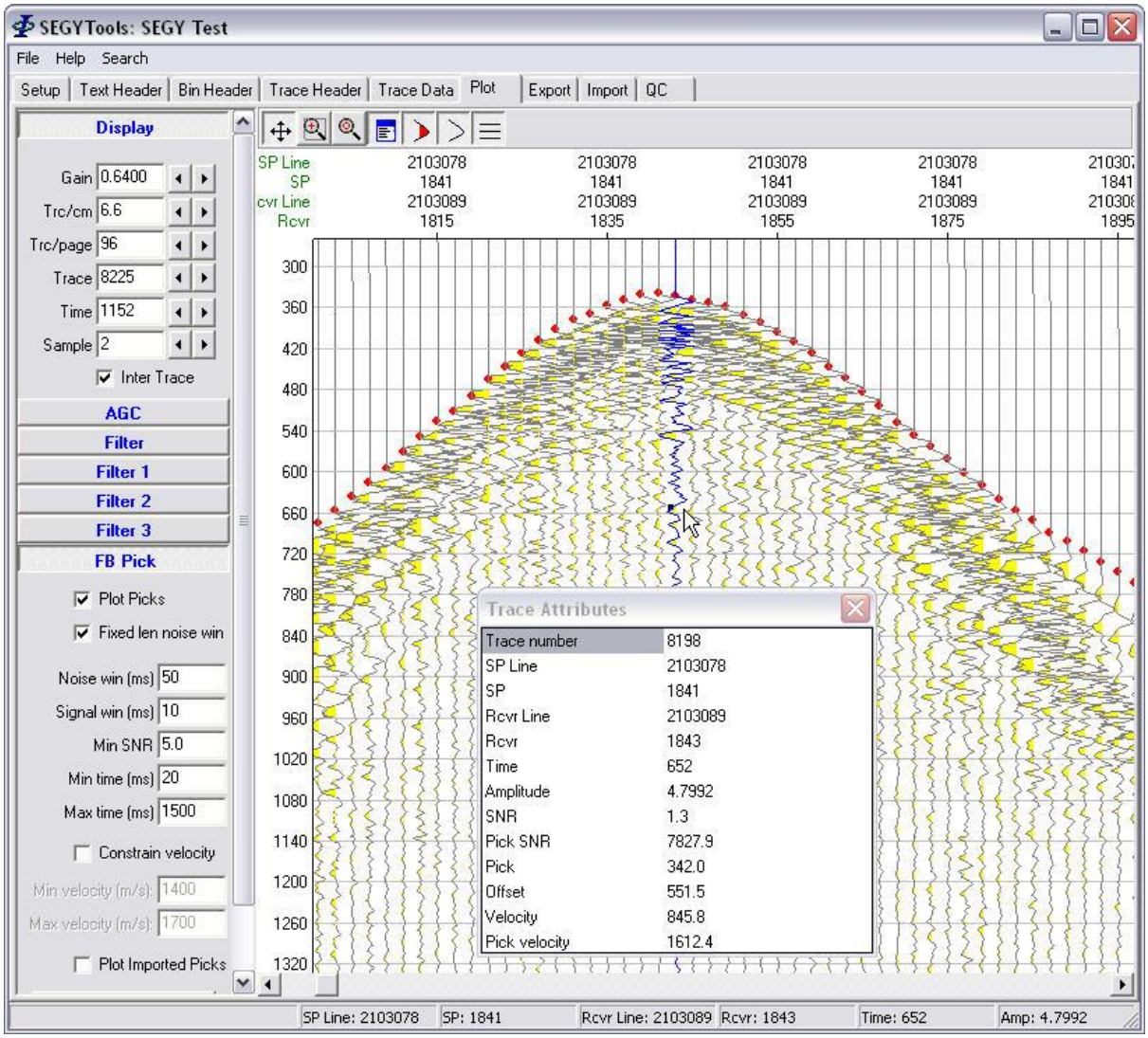

Figure 8-1 – Trace Plot

8.1 Toolbar

When depressed the mouse with the left button pressed can be used to pan the plot.


When depressed the mouse with the left button pressed can be used to zoom in.


Zoom out to the full record length.


Toggle display of the Trace Attribute window, shown in Figure 8-1.


Toggle wiggle fill display.


Toggle trace polarity.


Toggle time line display.

8.2 Display Parameter Group

The display controls can be changed by entering a new value or using the arrow buttons.

The following controls are provided:

Gain	Global gain scalar.
Traces/cm	The number of traces per centimetre.
Traces/page	The number of traces scrolled between pages when using the Trace arrows or clicking in the scrollbar.
Trace	The number of the centre trace. Clicking the left or right arrow button will display the previous or next page (see *Traces/page* above). See note below.
Time	The length of the time axis in milliseconds.
Sample	The sample rate used for display. This is a multiple of the sample rate defined in the binary header.
Inter Trace	Toggles inter-trace truncation. When checked the maximum amplitude displayed does not extend beyond the adjacent traces.

8.3 Scrollbar

Click or hold down the left or right arrows to shift the display to the adjacent traces.

Click or hold down the scrollbar in the space either side of the track bar to display the previous or next page as defined above under *Traces/page*.

When dragging the track bar the trace number of the track bar position is displayed in the *Trace* field (see *Trace* above).

Note: The typical setup for *Traces/page* would be to set this to the number of traces in the shot or receiver gather. Then, regardless of the zoom setting, clicking the either side of the track bar will display the same trace in the previous or next shot or receiver gather.

8.4 AGC Parameter group

The following controls are provided:

AGC on	Toggles automatic gain control on or off.
Gate	The window length over which RMS is computed.
Level	Gain control
Factor	Gain control

8.5 Filter Parameter Groups

Up to three filters can be applied simultaneously.

Global filter settings are controlled from the *Filter* group.

Individual filter parameters are controlled from the groups *Filter 1, Filter 2* and *Filter 3*.

The following controls are provided in the *Filter* group:

Filter on	Toggles filter on or off.
Length	Filter length in seconds.
Minimum phasing	Toggles minimum phasing on or off.
Apply	Click to apply all filter settings.

The required parameter fields for each individual filter appear when that type of filter is selected from the dropdown box.

The filter can be applied by either pressing the <*Enter*> key from any parameter field, or clicking the *Apply* button in the *Filter* group.

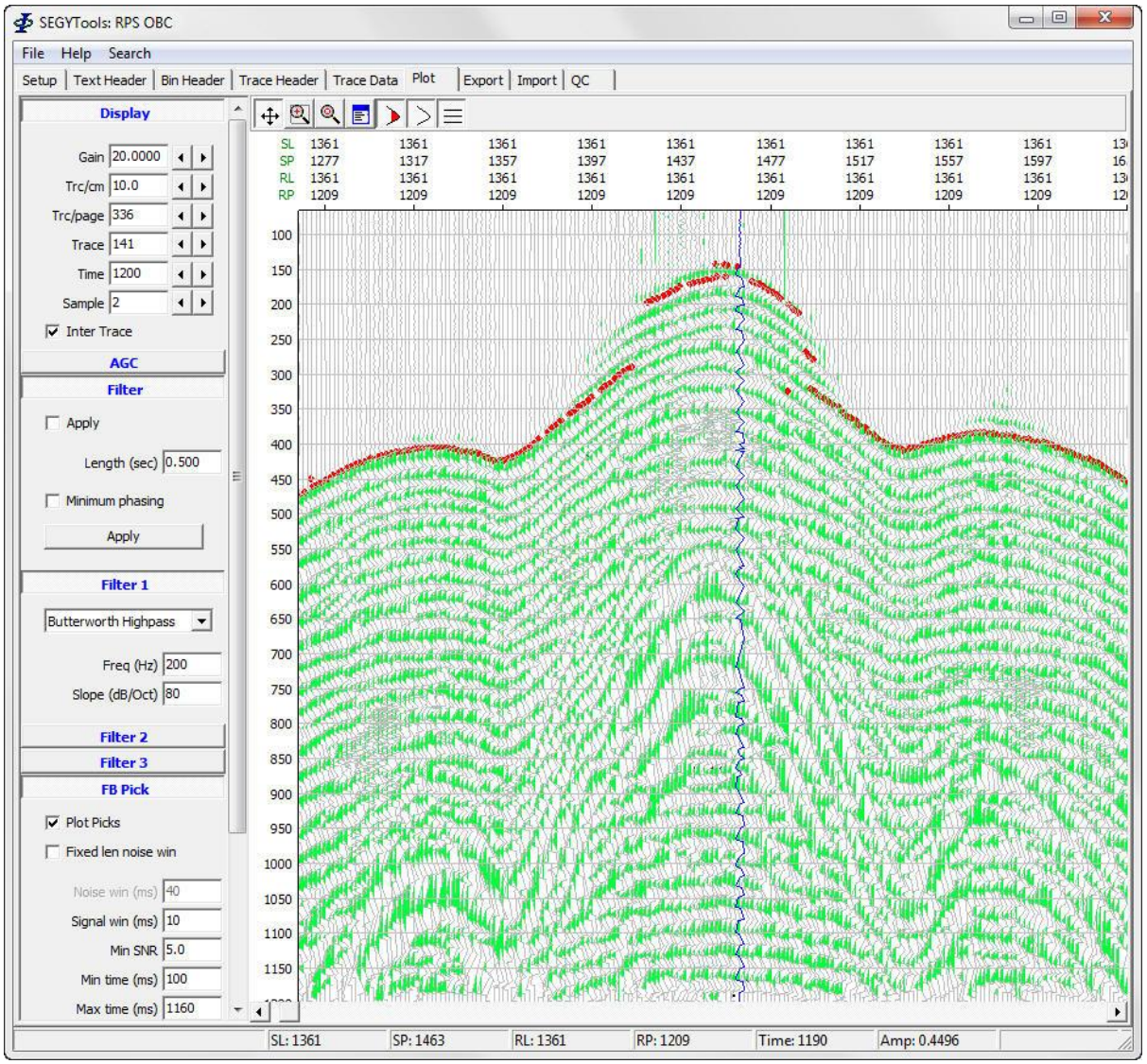

Figure 8-2 – Trace plot with picks, unfiltered

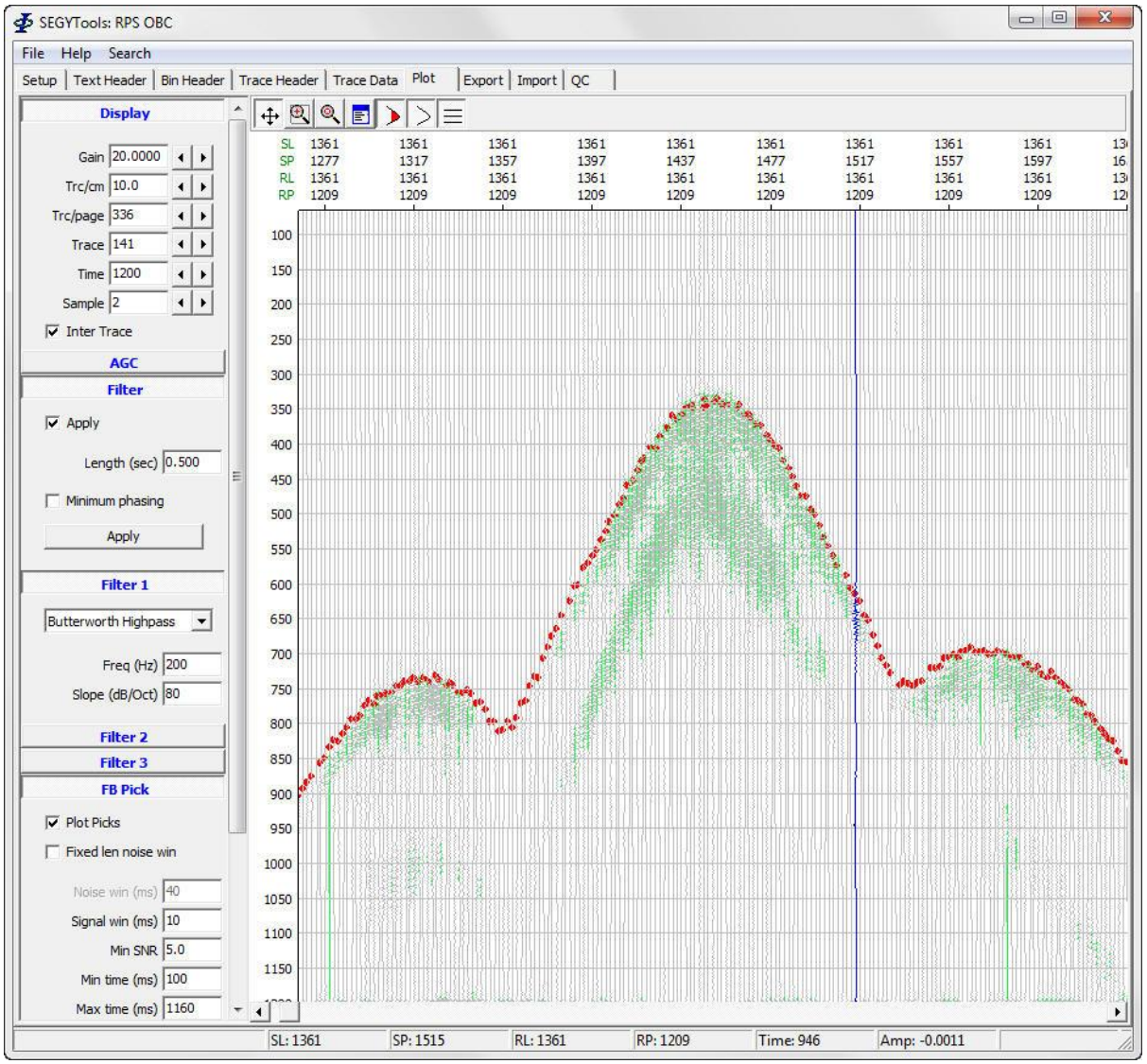

Figure 8-3 – Trace plot with picks, Butterworth HP 200KHz slope 80 dB/Oct

8.6 FB Pick Parameter Group

Picks are computed as the maximum ratio of the RMS of the defined signal window to that of the defined noise window. Picks are plotted for each trace as red circles.

The following controls are provided:

Plot FB Picks — Toggles display of the first break picks. These are plotted in red on each trace.

Fixed length — When checked, the noise window is specified by the Noise Window

noise window	parameter. When not checked the noise window is from the beginning of the trace to the current sample.
Noise window	The length of the noise window in milliseconds
Signal window	The length of the signal window in milliseconds
Minimum SNR	The signal to noise ratio below which a pick is rejected.
Minimum time	Picks computed less than the specified time are rejected.
Maximum time	Picks computed greater than the specified time are rejected.
Constrain velocity	Enable or disable velocity constraint. **Note:** The accuracy of the pick velocity will depend on the quality and integrity of positioning data read from the trace header. If this is uncertain then the velocity range should be set to 0-9999.
Plot imported picks	If external picks have been imported this checkbox is used to toggle their display on or off. Refer to section 10.1.1 for importing picks.

The specified parameters are applied by either pressing the <*Enter*> key from any of the parameter fields, or clicking the *Apply* button.

When exporting picks all picks are computed using the above specified parameters.

8.7 Linear Moveout (LMO) Parameter Group

The following controls are provided:

Apply	Toggle LMO display
Velocity	Specify the velocity to be used for LMO
Offset	Apply a time offset to maintain visibility of the plot.

8.8 Trace Attributes

Click the  button to toggle display of the *Trace Attribute* window. The following trace attributes are display for the trace and sample nearest to the mouse cursor:

Trace number	Trace number. The first trace in the dataset is 1.
<Annotation #>	<Annotation #> is that selected under *Setup.* Up to 6 fields can be

	defined.
Time	Time
Amplitude	Amplitude
SNR	Signal to Noise ratio at the cursor position
Pick SNR	Signal to noise ratio for the pick
Offset	Source to receiver distance computed from the coordinates in the trace header.
Velocity	Velocity at the cursor position.
Pick velocity	Velocity at the pick time.

9 EXPORT

The following export format options are provided:

- Shell Processing Support (SPS)
- Free format

Enter, or browse for, the export file name.

Set the trace range. To set the last trace in the file continue entering digits until the last trace number appears.

9.1 SPS Format

Before exporting to SPS format the source data for the fields defined by the SPS format must be specified. This is done with the following steps:

1. If necessary edit or add trace header fields (see sections 6.1 and 6.2) to ensure that the SPS attribute data is correctly read from the SEGY file.
2. In the Export page, select the *SPS Source Field* from the dropdown list in the top left of the table.
3. For each of the SPS fields required select from the dropdown list in the right hand column the appropriate field from the trace header. To delete an entry press the <Delete> key or right click and select *Delete* from the popup menu. If a field is blank then no data will be exported for that attribute and it will be blank in the SPS file.
4. Repeat for the *SPS Receiver Field*.

Check the *Export Sources* and/or *Export Receivers* checkboxes.

The specified export file name is used without the filename extension. For exported source files the extension ".S01" is appended. For exported receiver files the extension ".R01" is appended. For exported relation files the extension ".X01" is appended.

Only unique records are exported, in the order in which they are found in the SEGY file.

Attributes defining a unique source record are:

- Line number
- SP
- Index
- Code
- Grid coordinates
- Day of year
- Time

Attributes defining a unique receiver record are:

- Line number
- SP
- Index
- Code
- Grid coordinates

9.2 Free Format

The free format is used to export any data from the SEGY dataset, including first break picks. Each record in the export file comprises the required fields in the order in which they are listed, separated by commas, terminated with a carriage return and line feed.

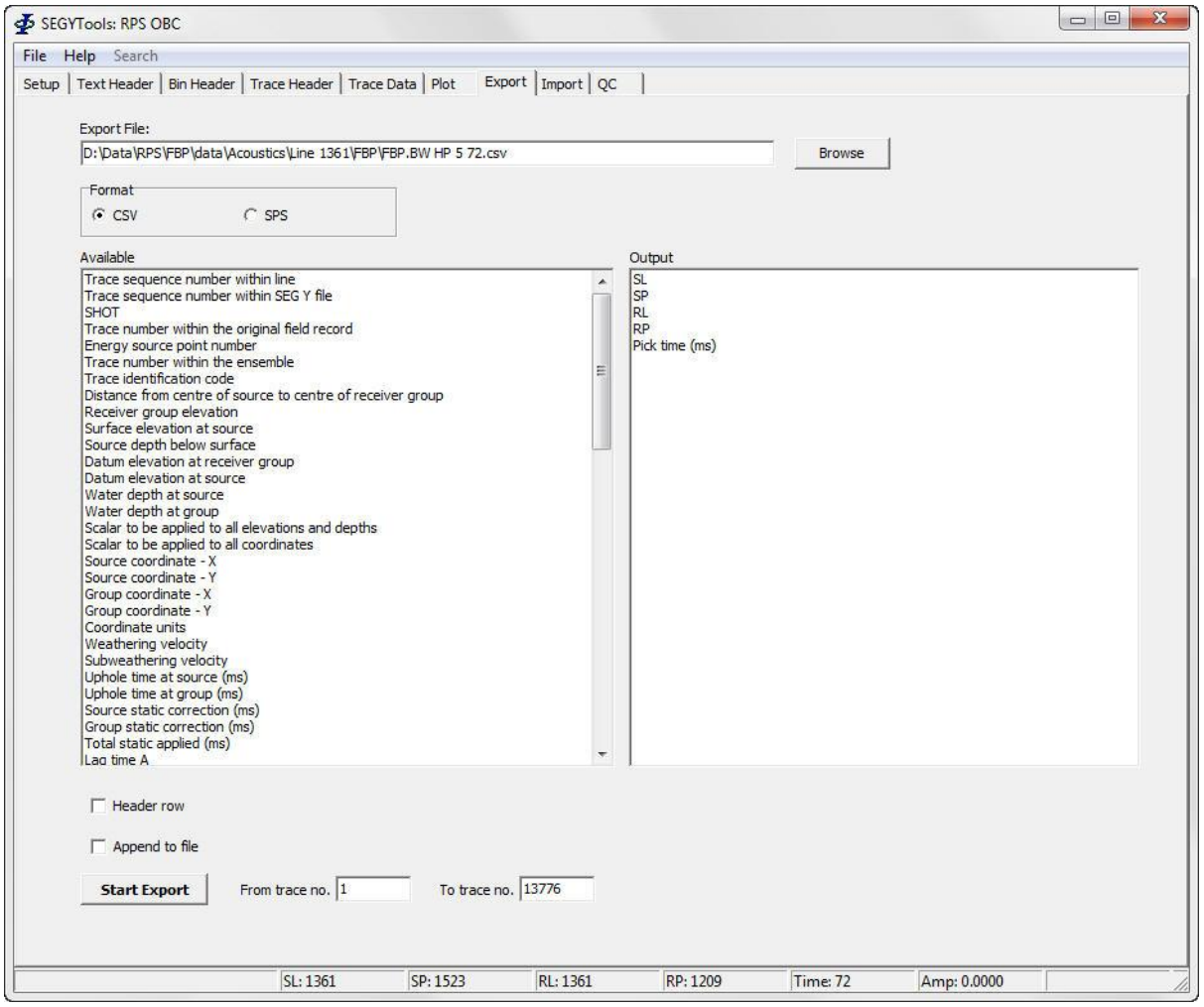

Figure 9-1 - Exporting FB Picks

To include or exclude a field either double click on it or drag it between the left *Available* list and the right *Output* list. Entries in the *Output* list may be re-ordered by dragging them within the list.

9.2.1 Exporting First Break Picks

First Beak (FB) picks typically require at least the following fields to be exported:

- Shot line number
- SP
- Receiver Line
- Receiver station number
- Pick time

Figure 9-1 shows a typical field selection for exporting FB picks.

The attribute *Pick time in milliseconds* must be included from the left hand list.

The FB pick times are computed using the parameters specified under the *FB Pick* parameter group in the *Plot* page.

Note: Only traces for which a valid pick can be computed will be exported.

Check the *Header row* checkbox to export the header to the first row.

Check the *Append to file* checkbox to append the exported data to the specified file.

10 IMPORTING DATA

Specify, or browse for, the import file name.

Specify the import file type. At present only delimited file types are supported.

10.1 Delimited Files

This would typically be used to import and overlay first break picks produced externally for comparison.

The field delimiter in the fie must be a *comma*, *space*, or <*tab*>.

A maximum of 7 import fields may be specified.

10.1.1 Importing First Break Picks

In order to import and display external first break picks the data in the external pick file must be synchronised with the trace data. This is achieved by specifying which trace header attributes are present in the file. These are selected from the list as shown in Figure 10-1.

The most likely attributes present in the file would be

- Source line
- SP
- Receiver line
- Station number

It is also necessary to include the additional attribute “Pick time in milliseconds” which is appended to the Available list.

The order of the fields must be the same as they appear in the file.

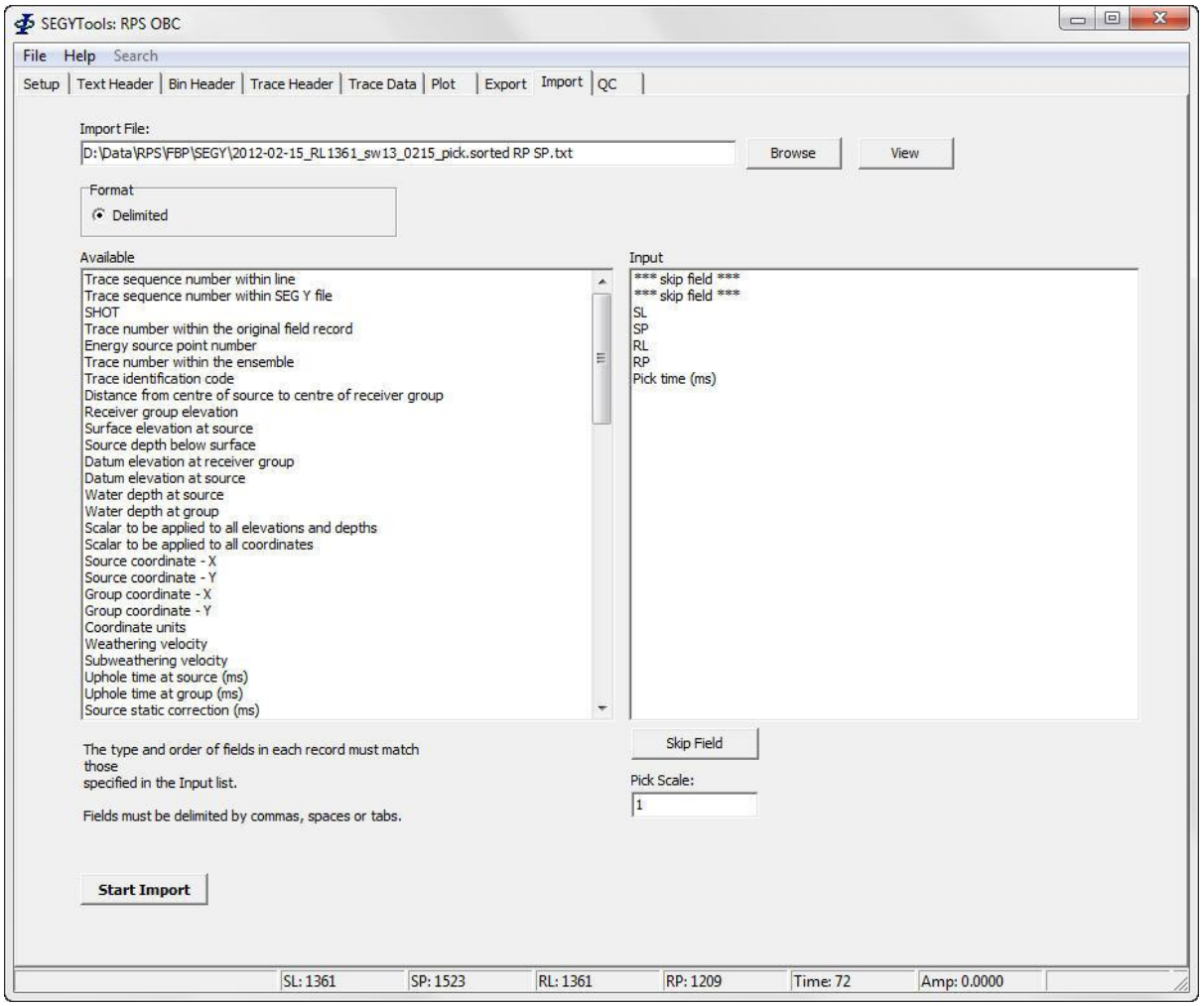

Figure 10-1 - Importing FB Picks

To include or exclude a field either double click on it or drag it between the left *Available* list and the right *Input* list. Entries in the *Input* list may be re-ordered by dragging them within the list.

To display the external picks, in the *Plot* page, *FB Pick* parameter group, check the *Plot External Picks* checkbox.

Fields in the file which are not to be imported must be represented in the list with a "*** skip field ***" entry. Click the *Skip Field* button to add a *skip field* entry.

To view the import file click the *View* button.

Figure 10-2 shows a trace plot with imported picks (blue) and computed picks (red).

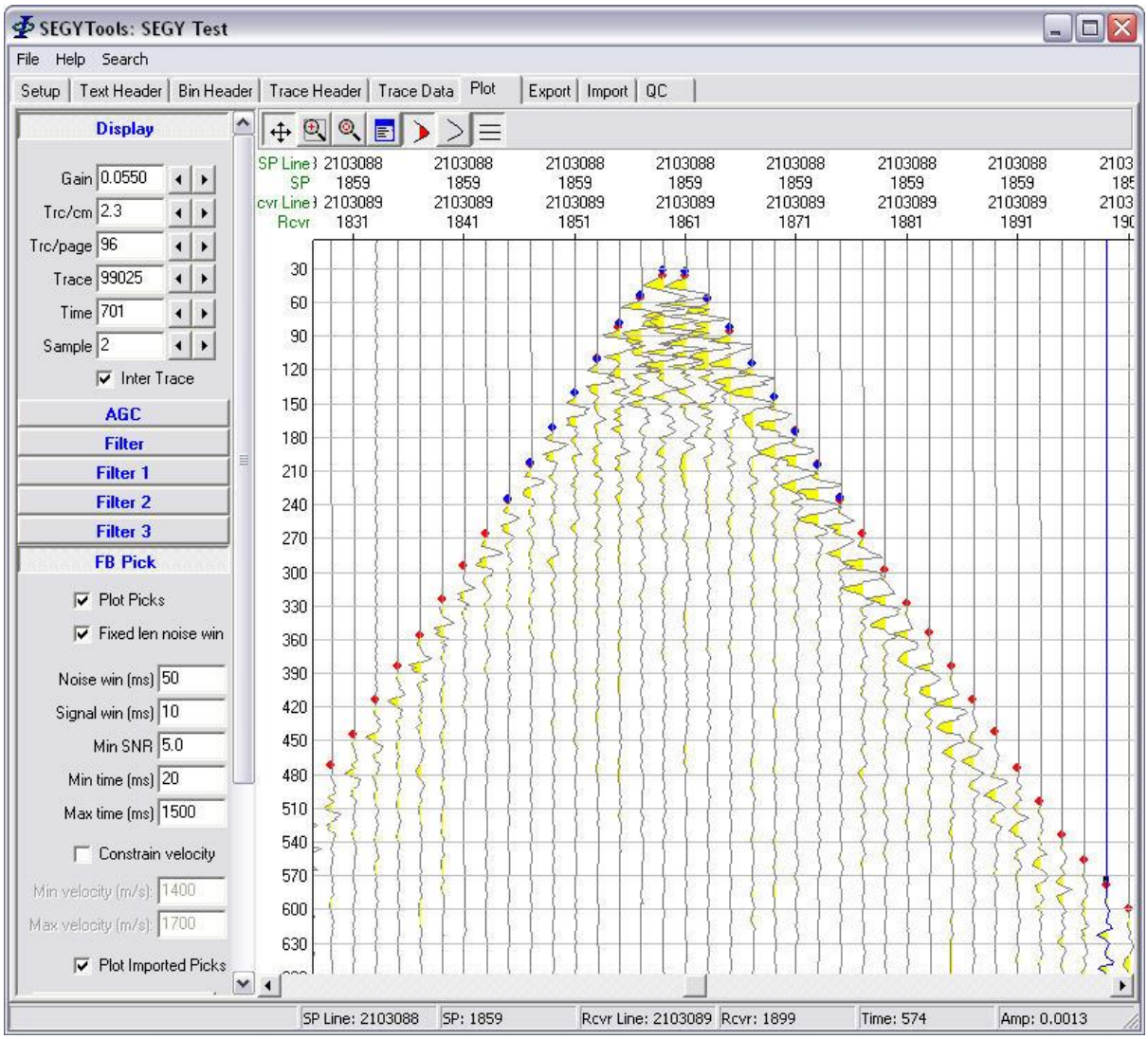

Figure 10-2 - Imported Pick Plot

11 QUALITY CONTROL (QC)

11.1 Pick compare

This module can be used to compare computed first break picks with imported first break picks.

Specify the first and last traces to be compares. The trace numbers can be found from the trace plot by displaying the *Trace Attribute* window.

Note: Specifying the entire trace range in the dataset may take a long time to run. It is advised to select a subset.

Click the *Start* button to start computing the comparisons.

Once the comparisons have been computed click the *Plot* button to display graphs of the computed picks, imported picks, and the difference between the computed and imported picks. An example is shown in Figure 11-1.

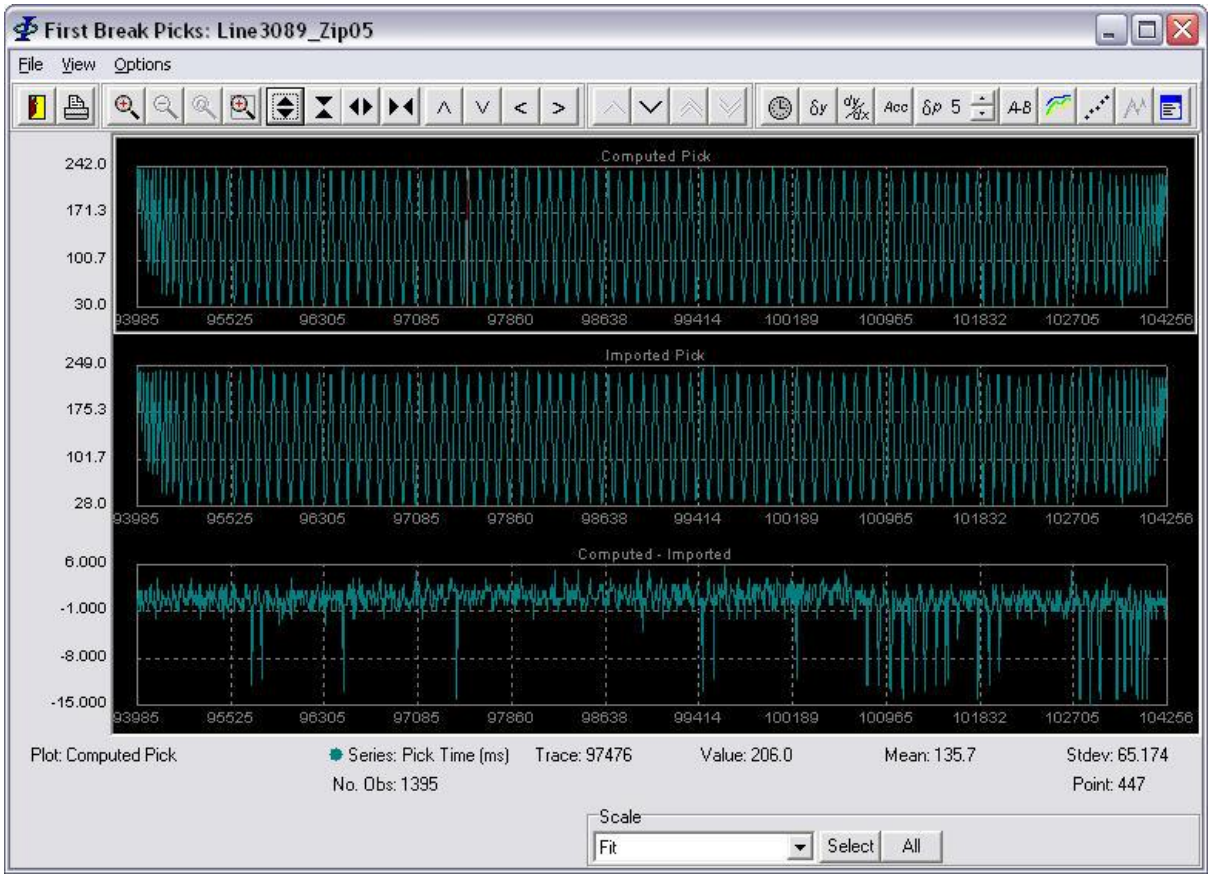

Figure 11-1 - Pick comparison graphs

For a description of the plotting functions refer to section 12.

12 MULTIPLOT

The multiplot module is the basic interactive time series plotting interface used throughout all FGPS software. Most features are common to all client modules although these modules may support various additional features specific to their application.

This section covers only the common Multiplot features used by all client modules.

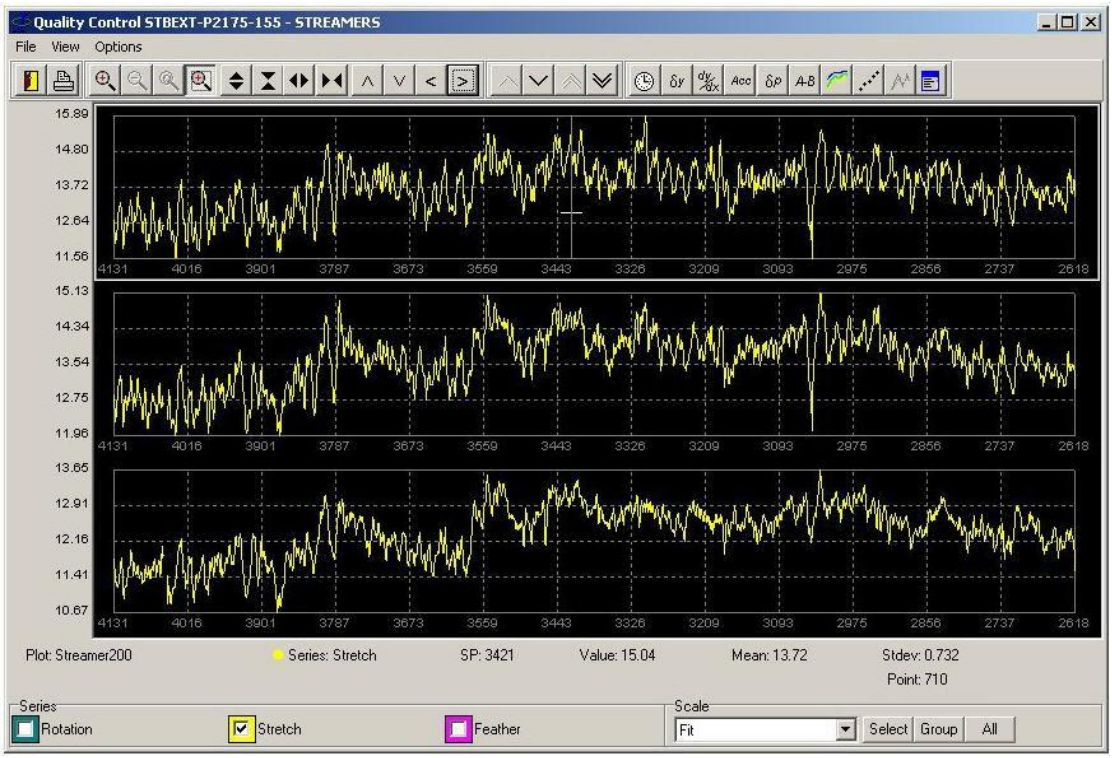

Figure 12-1 - Multiplot

12.1 Menu

File:

Print Current:	Prints the *active plot* as it appears on the screen on one full page using the current printer settings.
Print:	Allows selection of multiple plots as shown in figure 15.2. Plots will be printed as seen on the screen.
Printer Setup:	Invokes the Windows printer setup dialogue box.
Save Selected Plot Bitmap:	Displays the Save File dialogue box. Saves the *Selected Plot* to a bitmap file.
Save Form Bitmap:	Displays the Save File dialogue box. Saves the form to a bitmap file.
Exit:	Exits the Precondition module and writes all data to the database if any changes have been made.

View:

Zoom Factor:	*Allows the default horizontal zoom factor to be changed. The default is 2:1*
Grid Lines:	*Toggles grid lines on or off.*
Plots per Screen:	*Allows the number of visible plots to be changed to any number between 1 and 10 inclusive.*
Colour:	*Allows changing the colours of the individual plot series, interpolated values, edit line, nominal line and cursor lines.*
Cursor:	*Allows the horizontal and vertical cursors to be toggled on or off. The default is vertical on, horizontal off.*
List:	*Displays the list of all plots. The Active Plot is highlighted in the list and can be changed by clicking an item on the list.*
Network:	*Displays the Network Diagram.*

Options:

Load Palette:	*Loads a previously saved palette defining the plotting, edit and cursor colours.*
Save Palette:	*Saves the current plotting, edit and cursor colours.*
Hotkeys:	*Set the Hotkeys for deleting data using the edit line. Ctrl and Alt key combinations are not supported.*

12.2 Toolbar

 : Exits the Precondition module and writes all data to the database if any changes have been made.

 : Prints the *Selected Plot* as it appears on the screen on one full page using the current printer settings.

 : Expand the horizontal axis of all plots by the current zoom factor.

 : Contract the horizontal axis of all plots by the current zoom factor.

 : Fit the horizontal axis of all plots to the window.

 : When depressed enables the cursor to be used to zoom into any area of a plot. When up (default) enables the cursor to be used to draw an edit line on a plot.

 : Expands the vertical scale of the *Selected Plot* by two.

 : Contracts the vertical scale of the *Selected Plot* by two.

 : Expands the horizontal scale of the *Selected Plot* by two.

 : Contracts the horizontal scale of the *Selected Plot* by two.

 : Pans the *Selected Plot* up by one 20th of the vertical range.

 : Pans the *Selected Plot* down by one 20th of the vertical range.

 : Pans the *Selected Plot* left by half the horizontal range.

 : Pans the *Selected Plot* right by half the horizontal range.

 : Decrements the *Selected Plot* by one.

 : Increments the *Selected Plot* by one.

 : Displays the previous page according to the number of visible plots.

 : Displays the next page according to the number of visible plots.

 : Toggles the x-axis between shotpoint (default) and time in seconds from the first shot.

 : Toggles all plots between normal and point to point difference.

 : Toggles all plots between normal and rate of change.

 : Toggles all plots between normal and acceleration.

 : Toggles all plots between normal and difference from a least squares polynomial curve of specified order between 1 and 25 fitted through all good points.

 : Plots the difference between the *Selected Plot* and another plot. A plot list appears from which the comparison plot may be selected. Plotted values are the *Selected Plot* minus the comparison plot.

 : Overlays data from another plot selected from the list of all plots. Up to 10 overlays can be plotted.

 : Plots individual data points as a cross.

 : Plots the nominal value if available.

 : Displays the list of all plots. The *Selected Plot* is highlighted in the list and can be changed by clicking an item on the list.

12.3 Plots

Up to 10 plots can be displayed in one page. The list of plots can be browsed by scrolling using the toolbar buttons, the cursor and page up and down keys, or by selecting from the plot list.

12.3.1 Selected Plot

The *Selected Plot* is highlighted by a white 3D border and is selected by clicking in the plot area with either mouse button. The *Selected Plot* will change when scrolling through the plots or selecting from the plot list. Some of the toolbar functions are specific to the *Selected Plot* (see above).

12.3.2 Active Plot

The *Active Plot* is the plot which contains the mouse cursor, or the last plot to have contained the mouse cursor if the mouse cursor is outside the plotting area. When modifying any individual plot using the zooming and panning toolbar buttons the *Active Plot* becomes *Selected Plot*.

The statistics for the *Active Plot* are displayed below the plotting area.

12.4 Series

The available series are displayed in the *Series Panel* located at the bottom left of the window (see figure 15.1). The visibility of each series can be toggled by clicking on the series checkbox.

By default only the first series is displayed when the Multiplot module is instantiated.

12.4.1 Active Series

The *Active Series* is indicated by the information immediately below the bottom-most plot.

The statistical information displayed always pertains to the *Active Series.* Toggling on a series causes it to become the *Active Series*. If more than one series are displayed the *Active Series* can be changed by clicking on the series name in the *Series Panel*.

12.5 Scale

The y-axis scale of the plotted series for all plots is determined by the scale selected from the dropdown list in the *Series Panel* located at the bottom right of the window.
The following options are available for determining the maximum and minimum value plotted:

Series name:	Scale by the maximum and minimum value of the selected series.
Fit:	Scale to fit the maximum and minimum of all plotted series.
Max/min:	Specify a fixed maximum and minimum value.
Mean ± value:	Scale by the mean of the *Active Series* plus and minus a specified value.
Nominal ± value:	Scale by the nominal value of the *Active Series* plus and minus a specified value. This option is only available if nominal values are available.

When selecting one of the last three options above edit boxes appears enabling entry of the specified values.

The default scale is *Fit*.

After selecting the desired scale apply this by clicking one of the buttons adjacent to the scaling option dialog, described below:

Select:	Applies the specified scaling options to the *Selected* plot only.
Group:	Applies the specified scaling options to all plots in the same observation group (applies only to SeisPos Precondition module);
All:	Applies the specified scaling options to all plots.

12.6 Zooming

In addition to the zooming functions in the toolbar, mouse wheel scrolling can also be used.

To zoom horizontally hold down the <Ctrl> key and scroll the mouse wheel.

To zoom vertically hold down the <Shift> key and scroll the mouse wheel.

To zoom horizontally and vertically hold down the <Ctrl> and <Shift> key and scroll the mouse wheel.

Scroll up to zoom in and down to zoom out.

The centre of the zoom is the position of the mouse cursor.

12.7 Popup Menu

By clicking the right mouse button on any plot, that plot becomes the *Selected Plot* and a popup menu is invoked with the following functions which apply to the *Selected Plot* only:

Table:	Display a table of data for all series (see below).
Overlay key:	Display the colour key for overlaid plots.
Zoom out:	Zoom out plot to full extent.
Reset:	Revert to normal from comparison or overlay.

12.8 Plot Statistics

Plot statistics pertaining to the *Active Plot* are displayed below the plots as the cursor moves from plot to plot. If the plot is zoomed in then the statistics will pertain only to the visible data:

- Name.
- Mean value.
- Nominal value (if available).
- Standard deviation.
- Number of observations.

The following statistics are displayed for the cursor position:

- Shotpoint number, or if the *Time/shot* button is depressed the time in seconds from the first shot.
- Data point number (first point being 0).
- Value where vertical cursor intersects the plot. With the left mouse button depressed, the value at the cursor centre.

12.9 Data Table

To display a numeric table for the *Active Plot* select *Table* from the popup menu in the plot area.

When changing plotted data using the various display options, the data table currently visible will not be updated. There is, however, no limit to the number of tables which can be simultaneously displayed so, for example, it would be possible to display two tables, one showing time and the other showing shotpoint.

The table can be saved to file in comma or space delimited format by selecting *Save Table to File* from the table's popup menu.