



# USER MANUAL

# REFLECT SOFTWARE

For KI 6700 OTDR  
Multifunctional optical measuring device



## Record of Issues

If you have any suggestions for improvement to this document, please contact the author at Kingfisher International.

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**CONTENTS**

1	APPLICATION .....	5
2	GENERAL INFORMATION.....	5
3	REFLECT SOFTWARE OVERVIEW.....	5
3.1	Reflect Software Loading.....	5
3.2	PC Port Set-up.....	7
3.3	Software Main Window.....	8
3.4	Software Menu.....	9
3.4.1	<i>File Submenu</i> .....	9
3.4.2	<i>Measurement SUBMENU</i> .....	9
3.4.3	<i>MODE Submenu</i> .....	10
3.4.4	<i>COMPARE Submenu</i> .....	11
3.4.5	<i>ZOOM Submenu</i> .....	11
3.4.6	<i>SETUP Submenu</i> .....	12
3.4.7	<i>WINDOW Submenu</i> .....	12
3.4.8	<i>Toolbar</i> .....	13
3.5	Information Panel.....	15
4	MEASURING .....	16
4.1	Setting up Measurement Parameters.....	16
4.2	Starting Measurement.....	22
4.2.1	<i>Starting Measurement without Averaging</i> .....	22
4.2.2	<i>Starting Measurement with Averaging</i> .....	22
4.3	Window with a Trace.....	23
4.3.1	<i>Opening File with a Trace</i> .....	23
4.3.2	<i>Information Displayed in the Window with a Trace</i> .....	24
4.3.3	<i>Vertical and Horizontal Scaling</i> .....	25
4.3.4	<i>Markers Movement</i> .....	27
4.3.5	<i>Distance Measurement</i> .....	28
4.3.6	<i>Attenuation Measurement with Two Markers</i> .....	29
4.3.7	<i>Attenuation Measurement with Trace Approximation</i> .....	30
4.3.8	<i>Attenuation Measurement in OF Splices</i> .....	31
4.3.9	<i>Reflectance Measurement</i> .....	32
4.3.10	<i>ORL Measurement</i> .....	33
4.3.11	<i>Automatic Trace Analysis</i> .....	34
4.3.12	<i>Event Table</i> .....	35
4.3.13	<i>Marks on the Trace</i> .....	40

4.3.14	<i>Operator Work at Events</i> .....	41
4.3.15	<i>'Template' Function</i> .....	42
4.3.16	<i>Trace Filtration</i> .....	43
4.3.17	<i>Traces Comparison</i> .....	43
4.3.18	<i>Trace Description</i> .....	46
4.3.19	<i>Saving Traces</i> .....	50
4.3.20	<i>Printing Traces</i> .....	50
4.3.21	<i>Software Set-up</i> .....	51

## 1 APPLICATION

The Reflect Software is designed for controlling the KI 6700 OTDR and for viewing and analyzing trace files which were measured by OTDRs of various types and saved in the BELLCORE format.

The procedure for connecting the KI 6700 with a PC is described in the KI 6700 Operation Manual.

## 2 GENERAL INFORMATION

**Reflect Software** functions at Windows98/Me/2K/XP operation system.

**Reflect Software** is supplied on a CD and is installed onto a PC by means of running the **setup** file from REFLECT folder.

## 3 REFLECT SOFTWARE OVERVIEW

### 3.1 Reflect Software Loading

To load the software it is necessary to run the **reflect.exe** programme. After that the main window appears on the screen and the testing procedure of connection of the device and the PC (hardware initialization) is performed according to the software settings (see **4.3.21**). If the initialization process is performed successfully, the message with the connected device's type and number will appear on the screen (**Figures 3.1 and 3.2**).



**Figure 3.1**



**Figure 3.2**

If in the process of loading the software cannot communicate with the device (e.g. the device is not connected to the PC or not switched on), the corresponding message is displayed on the screen (**Figure 3.3**)



**Figure 3.3**

If the application can not establish the connection with the device because of the wrong port number (or type) is indicated in its settings, it is necessary to correct it in accordance with **3.2**.

## 3.2 PC Port Set-up

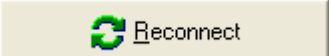


Figure 3.4

To carry out connection PC with KI 6700:

- select **Setup**→**PC Port** menu item in the main software window (see 3.3);
- set the parameters in the window shown in **Figure 3.4**;

- press the  and then the

 button.

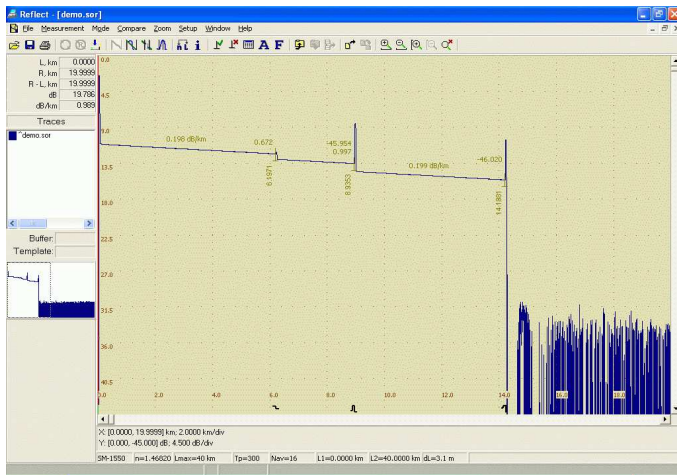
The connection between the PC & the OTDR will be established enabling remote control.

### 3.3 Software Main Window

As shown in **Figure 3.5**, the software main window includes:-

- a title line;
- a menu line;
- buttons toolbar;
- information panel in the left hand corner of the main window; it is displayed when the measurements are performed or the trace window is open.
- work area with a trace window(s).

During the measurement (opening), each trace is shown in a separate window.

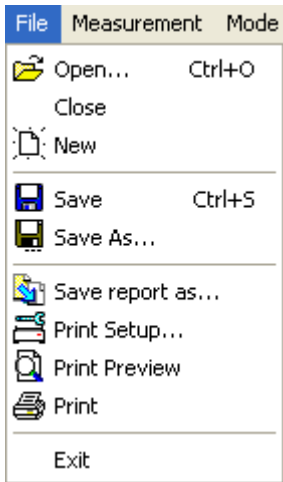


**Figure 3.5**

### 3.4 Software Menu

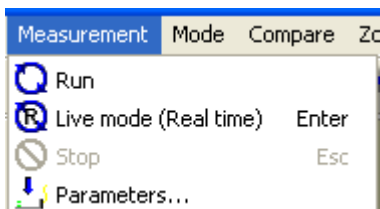
The software main menu consists of submenus and corresponding items. The keyboard buttons are provided in the right hand corner of the submenu. These buttons allow you to activate the corresponding menu items.

#### 3.4.1 File Submenu
















- opening the previously saved trace;
- closing the current trace window;
- creating new window for trace pasting;
- saving the current trace into the file;
- saving the current trace into the file under another name;
- print setup;
- print preview;
- printing the current trace;
- exit the application.

#### 3.4.2 Measurement SUBMENU



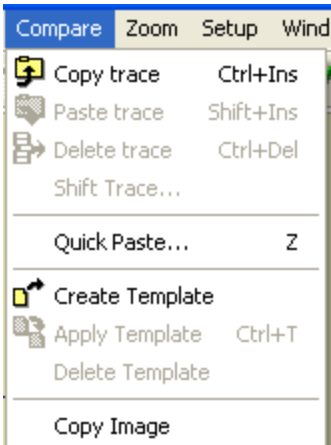
- **Run**: starts the OPTDR with averaging;
- **Live**: starts the OTDR without averaging;
- **Stop**: Stops the OTDR
- setting up initial measuring **Parameters**.

### 3.4.3 MODE Submenu

Mode	Compare	Zoom	Setup	W
	2PT attenuation			P
	LSA attenuation			D
	Splice Loss			S
	Reflectance			R
	ORL			O
	Refractive Index...			N
	Backscatter Coefficient...			B
	Trace Info...			I
	Insert Mark		Ctrl+Enter	
	Delete Marks		Alt+Del	
	Event table...			T
	Analysis			A
	Thresholds...			
	Filter			F

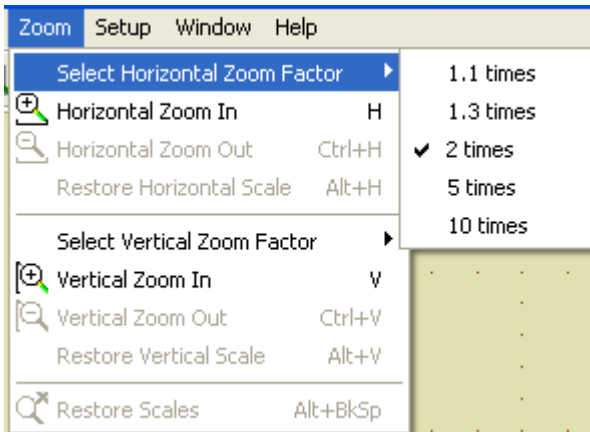
- attenuation measurement with two markers;
- attenuation measurement with trace approximation;
- attenuation measurement in OF splices;
- reflectance measurement;
- ORL measurement;
- OF refractive index adjustment;
- backscattered coefficient adjustment;
- trace information;
- fixing the event, corresponding to the current mode and markers position;
- delete all events between markers;
- activating the Event Table of the current trace;
- performing automatic trace analysis;
- setting automatic trace analysis thresholds parameters;
- measured trace filtration.

### 3.4.4 COMPARE Submenu



- copying the current trace to the buffer memory;
- pasting a trace from the buffer memory upon the current one;
- deleting the pasted trace;
- shifting the pasted trace vertically;
- quick trace pasting;
- storing the current trace events as a template;
- applying template to the current trace;
- deleting template;
- copy a trace image to the buffer memory.

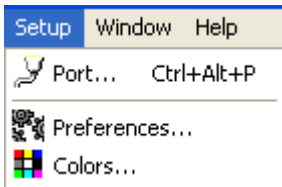
### 3.4.5 ZOOM Submenu



Selection of a submenu line provides:

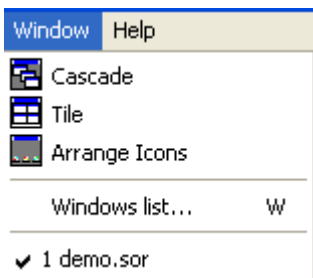
- select a horizontal (distance) scale change factor;
- zooming in a horizontal scale;
- zooming out a horizontal scale;
- restoring the initial horizontal scale;
- select a vertical (attenuation) scale change factor;
- zooming in a vertical scale;
- zooming out a vertical scale;
- restoring the initial vertical scale;
- restoring initial trace scales for both axes.

### 3.4.6 *SETUP Submenu*



- setting up the PC port for the KI 6700 connection;
- setting up software parameters;
- setting up a trace colour option.

### 3.4.7 *WINDOW Submenu*



- cascading trace windows;
- tiling trace windows;
- arranging minimized icons;
- list of open windows in the alphabetic order of file names;
- list of open windows with the marked active window.

### 3.4.8 Toolbar

The application of each toolbar button is given below; the corresponding PC key combination is given in square brackets.



– opening a file with a trace;



– saving the current trace to the file;



– printing the current trace;



– starting measurement process with averaging or pressing **[ENTER]**, during the measurement without averaging process;



– starting measurement process without averaging **[ENTER]**;



– stop the measurement process **[ESC]**, the key is only active when conducting measurements;



– setting up measuring parameters;



– attenuation measurement with two markers **[P]**;



– attenuation measurement with trace approximation **[D]**;



– attenuation measurement in OF splices **[S]**;



– reflectance measurement **[R]**;



– OF refractive index adjustment for a trace **[N]**;



– trace information **[I]**;















– fixing the event corresponding to the current measurement mode and marker position **[CTRL+ENTER]**;



– deleting all events in between the markers **[ALT+DEL]**;



– activating the Event Table **[T]**;

-  – performing automatic trace analysis [**A**];
  
-  – measured trace filtration [**F**];
-  – copying the current trace into the buffer memory [**CTRL+INS**];
-  – pasting a trace from the buffer memory upon the current one [**SHIFT+INS**];
-  – deleting the pasted trace from the active window [**CTRL+DEL**];
-  – storing the current trace events as a template;
-  – applying the template to the current trace [**CTRL+T**];
-  – zooming in a horizontal scale [**H**];
-  – zooming out a horizontal scale [**CTRL+H**];
-  – zooming in a vertical scale [**V**];
-  – zooming out a vertical scale [**CTRL+V**];
-  – restoring initial scale for both axes [**ALT+BKSP**];

### 3.5 Information Panel

Information panel is displayed in the left hand corner of the main window, when the measurements are being performed or the trace window is open. It includes the following data relative to the current trace (window):

L, km	7.6541
R, km	19.9999
R - L, km	12.3458
dB	41.879
dB/km	3.392

Traces

- ^demo.sor
- 155\_80km\_20mks.sor
- abc.sor
- Dz\_131.sor

Buffer: Dz\_131.sor  
Template: abc.sor



- left marker position (**L, km**);
- right marker position (**R, km**);
- distance between the markers (**R-L, km**);
- attenuation between the markers (**dB**)<sup>1</sup>;
- attenuation coefficient between the markers (**dB/km**)<sup>1</sup>.

- traces list (main and pasted) in the active window along with the corresponding to them colours;

- name of file located in the buffer memory;
- name of file used as a template;


Overview window with the active trace; the trace part displayed in the window after zooming is marked by a pointed rectangle and markers – by dashed lines.


1) Contents of these data boxes depends upon the chosen measurement mode. Refer Sections 4.2.6 ~ 4.3.10

## 4 MEASURING

The following actions are accessible if the KI 6700 is connected to a PC and is successfully initialized during software loading..

### 4.1 Setting up Measurement Parameters

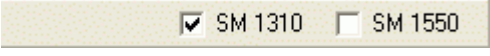
**4.1.1** Before starting the measurement process, it is necessary to set up its parameters. Select the **Measurement** → **Parameters** menu or press  button of the buttons menu. The dialog box shown in **figure 4.1** is displayed afterwards in which it is necessary to set up numerical values of the appropriate parameters.

**4.1.2** The line  serves for choosing the mode of OF measuring.


**Manual** – measuring will be performed at the parameters set up by the user.

**Auto** – the process of measuring being started, the software chooses the main parameters itself in accordance with the particularities of the connected OF, part of the parameters being set up by the user.

*In the present Software version the AUTO mode is not available. It is planned to introduce a Reflect Software update in the near future to enable this feature.*

**4.1.3** The line  serves for choosing wavelength (one or two) at which the measuring will be performed.

**4.1.4** The **Measurement parameters** window has two tabs for setting the parameters of each wavelength.

When the  button is pressed, all measurement parameters are set up both for the first and the second wavelength.

If two wavelengths are chosen for measuring, an area in the **Measurement parameters** window is marked which includes parameters automatically set up equal for both wavelengths.

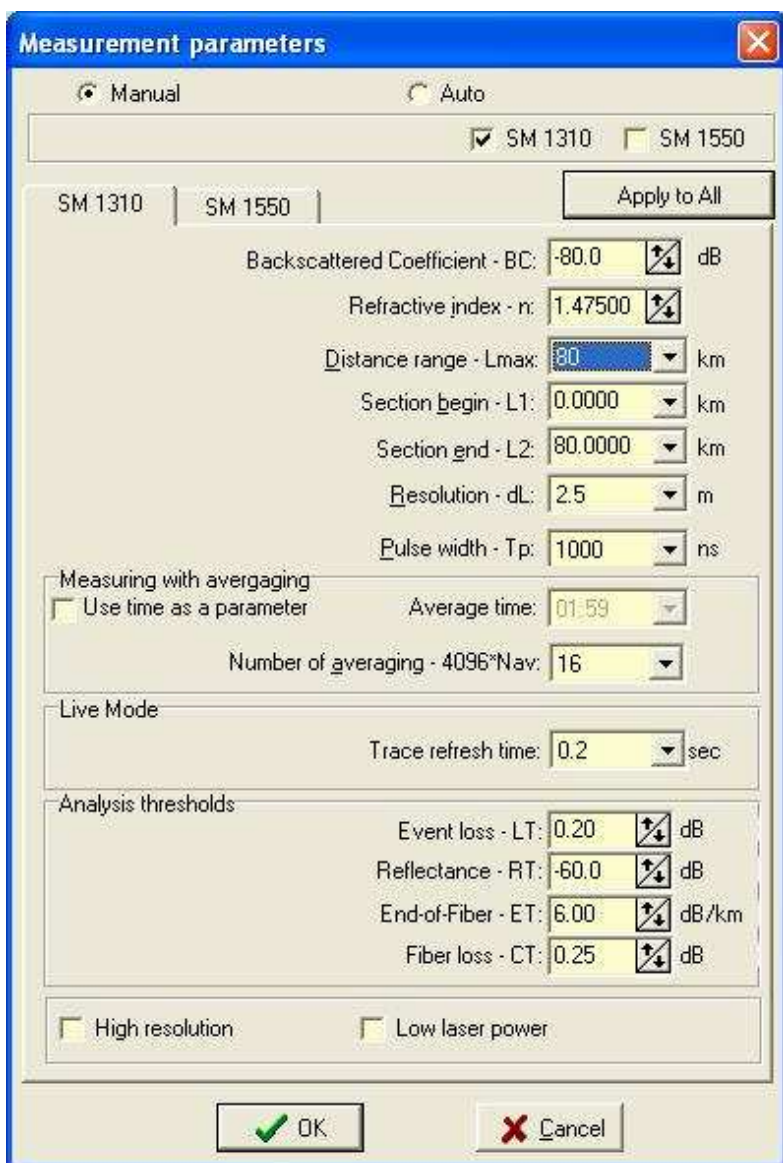


Figure 4.1

#### 4.1.5 Measurements parameters have the following sense:

**Backscattered coefficient – BC** – a power portion (in **dB**) which is being scattered in OF and spreading to OF beginning when optical pulsewidth is 1 ns.

Default values are:

80 dB for SM OF and wavelength 1310 nm;

81 dB for SM OF and wavelength 1490 nm;

81 dB for SM OF and wavelength 1550 nm;

82 dB for SM OF and wavelength 1625 nm;

72 dB for MM OF and wavelength 850 nm;

75 dB for MM OF and wavelength 1300 nm.

Backscattered coefficient can be changed with a step of 0.1 dB.

**Refractive index – n** – is used for distance calculation.

Default values are:

1.4675 for SM OF and wavelength 1310 nm;

1.4680 for SM OF and wavelength 1490 nm;

1.4682 for SM OF and wavelength 1550 nm;

1.4686 for SM OF and wavelength 1550 nm;

1.490 for MM OF and wavelength 850 nm.

1.486 for MM OF and wavelength 1300 nm.

OF refractive index value can be changed with a step 0.00001.

**Distance range - Lmax** – maximum value of measured distances; takes the values: 2, 5, 10, 20, 40, 80, 120, 160 and 240 km. The value of **Lmax** must exceed the possible length of the measured line. **Lmax** parameter determines the period of pulse launch which is to be more than twice the time of light propagation in OF.

**Beginning of section– L1** - distance from the OF start to the beginning of the section under test; takes any values within the range of 0 up to **Lmax**.

**End of section – L2** - distance from the OF start to the end of section under test; takes any values within the range of **L1** up to **Lmax**.

**Resolution – dL** – Distance between two trace sampling points (sampling resolution); depending on the set distance range **Lmax**, **dL** takes the values 0.32; 0.64; 1.3; 2.5; 5.1; 3.8 and 7.6 m.

**Pulsewidth – Tp** – optical pulse width value; takes the following values:

- SMF OTDR: 6, 12, 25, 100, 300, 1000, 3000, 10000, 20000 ns
- MMF OTDR: 6, 12, 25, 100, 300 and 1000 ns.

The pulsewidth range depends on the chosen **Lmax** value and is automatically limited by the programme.

## Measurement with averaging.

**Number of trace averagings 4096\*Nav** – defines the total number of trace averaging within measurement with averaging mode. The entered value **Nav** takes the following values 1, 2, 4, 8, 16, 32, 64, 128, 256. The total number of averaging will equal to 1\*4096, 2\*4096, 4\*4096 etc.

**Measurement time (min:sec)** – sets the time of measurement with averaging. The following values can be set: 5, 15 or 30 seconds, 1, 3 or 10 minutes.

If the operator sets the number of trace averaging, then the approximate time of measurement is automatically displayed. If the operator sets the measurement time, then the corresponding number of trace averaging is automatically calculated.

**Live Mode** (measurement without averaging).

**Trace refresh period** – sets how often the trace on the screen will be refreshed in a real time measurement mode. It acquires the following values: 0.2, 0.5, 1.0, 2.0 sec.

## Threshold values for the automatic trace analysis

Parameters set for the automatic trace analysis have the following meaning:

**Event loss (LT)** – attenuation threshold value in the event, **dB**; events the attenuation in which exceeds the threshold value are shown in the Event Table at the automatic trace analysis (see **4.3.11**). Default value set is 0.1 dB.

**Reflectance (RT)** – reflection coefficient threshold value, **dB**; events the reflectance of which exceeds this threshold value are shown in the marks table at the automatic trace analysis (see **4.3.11**). Default value set is -50 dB.

**End-of-fiber (ET)** – attenuation threshold value, **dB**, to detect OF end; the first event the attenuation of which exceeds the threshold value is defined as OF end; all subsequent events are ignored (see **4.3.11**). Default value set is 6 dB.

**Fiber Loss (CT)** – section attenuation coefficient threshold value, **dB/km**; the excess of attenuation coefficient threshold value is marked with symbol \* in the Event Table (see **4.3.12**). Default values set are:

- 0.4 dB/km for SM OF and wavelength 1310 nm;
- 0.35 dB/km for SM OF and wavelength 1490 nm;
- 0.25 dB/km for SM OF and wavelength 1550 nm;
- 0.3 dB/km for SM OF and wavelength 1625 nm;
- 1.0 dB/km for MM OF and wavelength 1300 nm;
- 3.0 dB/km for MM OF and wavelength 850 nm.

**High Resolution** – in this mode the bandwidth of the optical receiver is increased, which makes it possible to decrease the dead zone and better detect the closely located events. But in this mode the optical receiver noise increases.

**4.1.6** Measurement parameters values set by the user depend on OF (line) prospective parameters: length and average attenuation.

When measuring these characteristics with OTDR the maximum value of measured attenuation increases proportionally to the pulse width (and according to its energy), but at the same time spatial resolution is worsened as optical pulse spatial length is connected to its duration by a ratio:

$$L_p = c \frac{T_p}{2n} \quad (1)$$

where  **$T_p$**  - duration of the pulse,  **$c$**  – light speed in vacuum,  **$n$**  – index of refraction. For example, to pulse width  **$T_p = 300$  ns** corresponds  **$L_p \approx 30$  m**. That means that it is practically impossible to distinguish between 2 non-reflective events (such as fusion splices), when the distance between them is less than  **$L_p$** .

On the other hand it is possible to increase the dynamic range of the OTDR by increasing the averaging or measurement time.

The dynamic range increases by about 0.75 dB when the averaging time is doubled.

The  **$L_{max}$**  value set before the start of measurement must increase the length of measured line.

If the length of the line is close to any  **$L_{max}$**  value (exceeds  $2/3 * L_{max}$ ), the presence powerful pulse in the backscattered signal reflected off the far OF end can lead to small attenuation distortions in distant line sections or to the occurrence of Ghosts (false reflected pulses) on a smooth trace section. To avoid this, it is recommended to select the  **$L_{max}$**  value not less than twice the line length.



## 4.2 Starting Measurement


### 4.2.1 Starting Measurement without Averaging


To start the measurement without averaging, select the **Measurement** →

**Live mode (Real time)** or press  button or press the **ENTER** key.

After switching to the mode of the measurement process without averaging the current submenu item becomes inaccessible till the measurement

process is stopped.  button becomes the  for stop of the measurement process.

At the same time a laser danger sign  is highlighted in the bottom part of the main programme window. The speed of a trace change is displayed in the next window of the same line: the more the period of a trace update, the more slowly the window is filled up.


To stop the measurement process, press **Esc** key or select **Measurement** → **Stop** or press  button.

In the mode of the measurement without averaging the trace is displayed on the screen with a definite time interval. The image is completely updated, averaging is not performed. This mode is a viewing one and is mainly used when adjusting two OFs before splicing or to identify the attached OF and other similar cases.



If measurement without averaging is being performed and the trace is displayed on the screen, the second pressing of the **ENTER** button allows you to switch to the mode of measurement with averaging (see 4.3).

### 4.2.2 Starting Measurement with Averaging


To start the measurement with averaging, select the **Measurement** → **Run**

or press the  button or press the **ENTER** key if OTDR is already performing measurement without averaging.

After switching to this mode of measurement with averaging current submenu item becomes inaccessible till the end of the measurement

process.  button becomes  for stop of the measurement process.


At the same time a laser danger sign  is highlighted in the bottom line of the main window.

To stop the measurement press **Esc** key or select **Measurement → Stop** or press  button.

The mode of measurement with averaging is designed for OF measurement with the subsequent analysis of its parameters. At the same time the measurement results are averaged. In the bottom line of the main software window the display shows a counter, which indicates the current value of parameter Nav and the relative scale of the measurement time. The measurement process is completed when Nav parameter acquires the value set by the user (see 4.2).


## 4.3 Window with a Trace

### 4.3.1 Opening File with a Trace

To open a previously saved trace select **File → Open...** or press the  button. The next window will appear on the screen (**Figure 4.2**).

The left part of the window looks like standard Windows open file dialog box.

If the selected file contains a trace, it will be displayed in the right part of a dialog box with measurement parameters. In order to look through more

detailed information about a trace press  button in the right bottom corner of the window (see 4.3.18).

The software enables opening traces measured by other manufacturer's OTDRs which have been saved in the SOR format.

The KI 6700 will open/ save traces in the Bellcore/Telcordia versions 1.0, 1.1 and 2.0 SOR format.

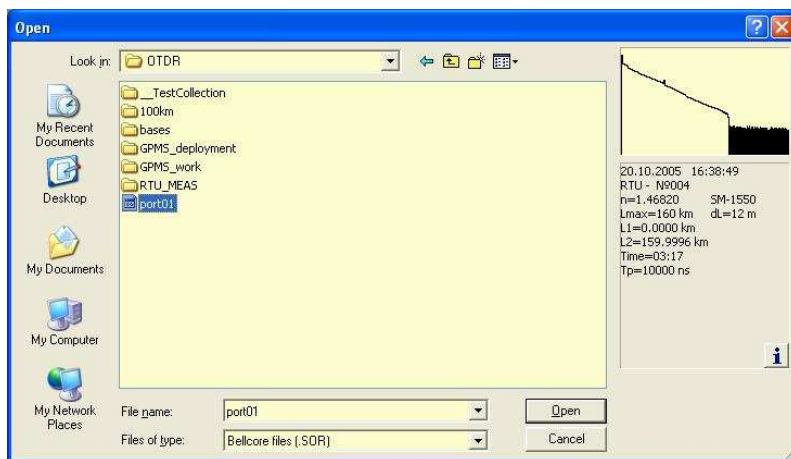


Figure 4.2

### 4.3.2 Information Displayed in the Window with a Trace

In this window (**Figure 4.3**) a trace and two active vertical markers are shown. The markers location is shown in the two top lines of the information panel on the left.

The bottom part of the window shows the following information:

- position data of the left and right window borders and the horizontal scale;
- position data of the top and bottom window borders and the vertical scale;
- trace measurement parameters (see 4.1):
- **SM - 1310** - OF type and wavelength;
- **n** - refractive index;
- **Lmax** – distance range;
- **Tp** – optical pulsewidth;
- **Time** (or **Nav**) – measurement time (or parameter describing general number of trace averaging);
- **L1** – distance from OF beginning to the beginning of measured section, km
- **L2** – distance from OF beginning to the end of measured section, km;
- **dL** – resolution, m.

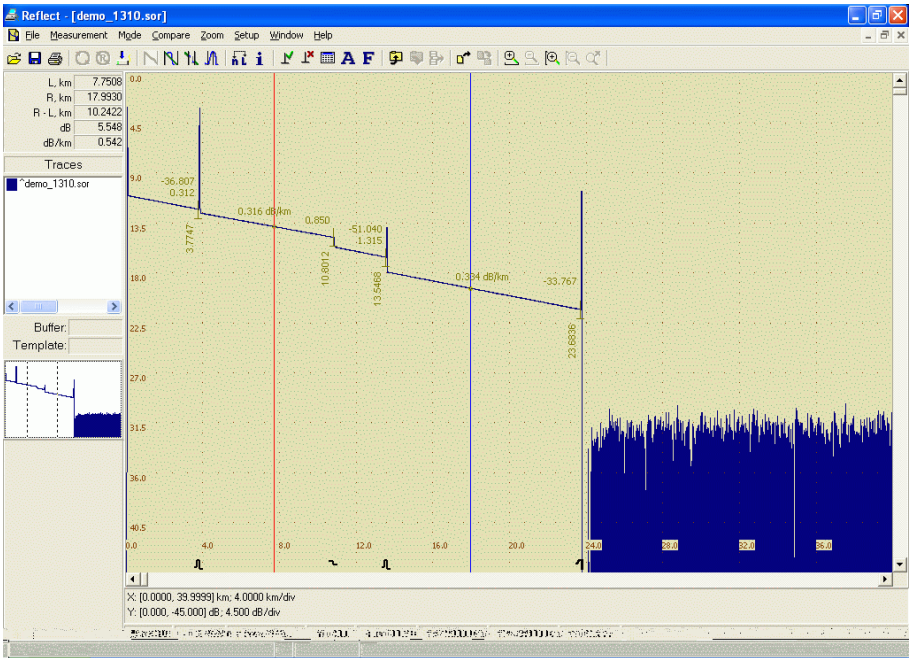



Figure 4.3

### 4.3.3 Vertical and Horizontal Scaling

**4.3.3.1** A trace, displayed in a window, can be stretched horizontally and vertically. It can be done with:

- 1) menu item **ZOOM** (see 3.3.5);
- 2)  toolbar buttons (see 3.3.8);
- 3) the PC keys indicated in Table 4.1;

The trace can be zoomed with respect to:

- the left side of the trace window;
- the right side of the trace window;
- the center of the trace window;
- the scroll box.

Function	Hot keys
Zooming in a horizontal scale in accordance with a given scale change factor	H
Zooming out a horizontal scale in accordance with a given scale change factor	CTRL+H
Restoring the initial horizontal scale	ALT+H
Zooming in a vertical scale in accordance with a given scale change factor	V
Zooming out a vertical scale in accordance with a given scale change factor	CTRL+V
Restoring the initial vertical scale	ALT+V
Restoring initial trace scales for both axes	ALT+BkSp

**Table 4.1.**

The zoom mode is set at the parameters setup (see **4.3.21**). The change scale relative to scroll box location is established by default.

The trace area displayed on the screen after zooming is marked out with dotted contour in overview window of the information panel, located in the left part of the screen.

**4.3.3.2** The scale change factor (horizontal and vertical) can be chosen using menu of the programme or toolbar buttons:

- to select the scale change coefficient choose the **Select Horizontal Zoom Factor** or **Select Vertical Zoom Factor** item of the **ZOOM** submenu;
- to select the scale change factor click right mouse button on one of the



buttons and select scale change factor by click of the left mouse button.

Available values of the scale change factor are: 1.1; 1.3; 2; 5; 10.

**4.3.3.3** Trace zoom are also available by simultaneous pressing **Alt** key and **left mouse button** and dragging the mouse pointer on the screen. A rectangular outline will appear on the screen, which shows the contour of the new stretched section. After releasing the left mouse button the trace will become stretched.

If the mouse pointer is moved **from the left to the right** and **from top to bottom**, the section selected in this way will zoom in **vertically** and **horizontally**.

If the mouse pointer is moved **from the left to the right** and **from bottom to top**, the section selected in this way will zoom in only **horizontally**.


If the mouse pointer is moved **from the right to the left** and **from top to bottom**, the section selected in this way will zoom in only **vertically**.

The zoom is cancelled by moving the mouse pointer from the right to the left and from bottom to top.

**4.3.3.4** To **scroll around** the trace, use the mouse, the scroll bars in the main software window or use the key combination: **Alt** and ←, ↓, →, ↑.

#### **4.3.4** *Markers Movement*

Marker movement upon a trace can be done by two methods: using a mouse or PC keys.

To move a marker with the help of the mouse, place the mouse pointer on a marker, wait till the mouse pointer changes to , click the left mouse button 'catch' the marker and move it to the necessary position.

Besides, the left (right) marker can be moved to any point on a trace window by moving the mouse pointer to the necessary point, then clicking the corresponding (left or right) mouse button.

Moving the markers it is not allowed to place the left marker to the right of the right marker and vice versa.

Moving markers with the keys, as described in Table 4.2:

Marker	To the left	To the right
Left	←	↑
Right	↓	→
Both simultaneously	CTRL + ↓	CTRL + ↑
In the event attenuation measurement mode with 5 markers (see 4.3.8)		
Left subsidiary	SHIFT + ←	SHIFT + ↑
Right subsidiary	SHIFT + ↓	SHIFT + →
Central marker	CTRL + ←	CTRL + →
All simultaneously	CTRL + ↓	CTRL + ↑

**Table 4.2.**


When moving markers, their location (distance from the beginning of the OF) is shown in the top part of the information panel.

#### 4.3.5 Distance Measurement

To measure distance to the event, a marker should be placed at the left side of the event. Read the distance in the appropriate table line of the information panel.

For a more accurate measurement, it is recommended to zoom the trace horizontally and vertically.

As follows from the formula (1) given in **4.1.6**, the accuracy of distance measurement on the trace depends in particular on the accuracy of the OF refractive index set-up. If it is unknown, but the length of the measured OF is known, it is possible to adjust index or refraction in such a way that the OF length measured on the trace coincides to the known value.


To do it, choose the menu item **Mode → Refractive index** or press the **N** key or  button on the toolbar.



**Figure 4.4**

After that the window (see **figure 4.4**) which appears on the screen shows the markers location and allows to change refractive index value.

At the refractive index changing markers locations are recalculated.

Pressing the  button or the **ENTER** key fixes the new OF refractive index value for the current trace.

Press the  button or the **ESC** key to return the original reference value.

#### 4.3.6 Attenuation Measurement with Two Markers

To perform attenuation measurement on any OF section and its length, place the markers on both ends of this section and read its characteristics in the top table of the information panel (see **figure 4.5**). This is two point (2PT) attenuation measurements.

To select the two point attenuation measurement or to return to this measurement mode from any other mode (see below) choose the menu item

**Mode** → **2PT attenuation** or press the  button or the **P** key.

To measure the attenuation and length of an OF section, place the markers on the ends of the section, then read its characteristics in the top table of the information panel (**figure 4.5**):

**R-L, km** - section length,

**dB** - the attenuation between the markers;

**dB/km** - the attenuation coefficient value.

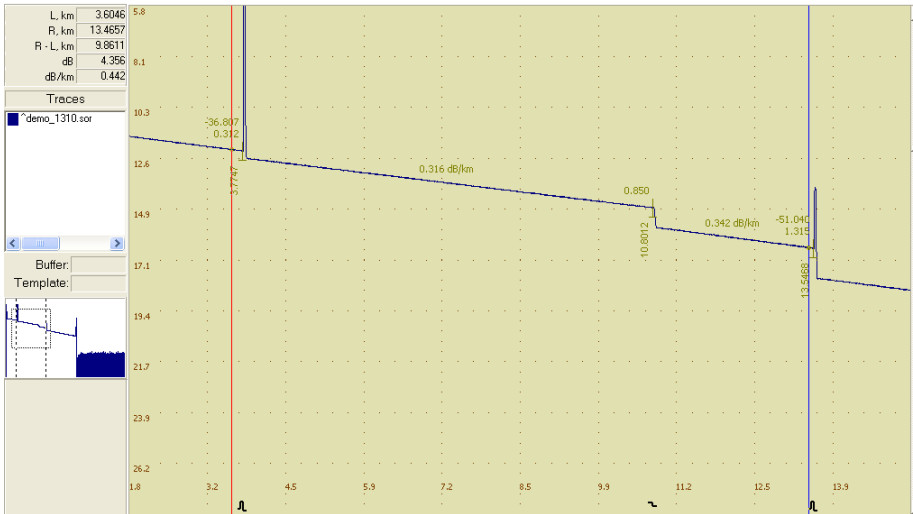



Figure 4.5

When measuring attenuation in the whole OF the left marker should be placed outside the dead zone.

#### 4.3.7 Attenuation Measurement with Trace Approximation

To improve the accuracy of attenuation measurement, the trace section between the markers can be approximated with a straight line. Approximation is realized by least-squares method (LSA).

To access this mode, choose the menu item **Mode** → **LSA Attenuation** or

press the  button or press the **D** key. The approximating straight line is displayed on the screen (figure 4.6). The result of attenuation measurement are shown in the fourth and fifth lines of the information panel table.

This method of measurement should be applied to the uniform sections having no splices.

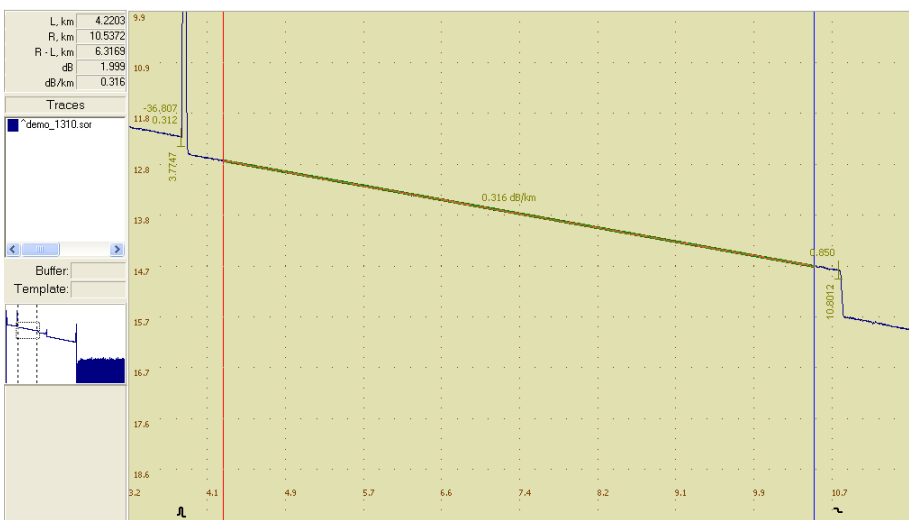


Figure 4.6

### 4.3.8 Attenuation Measurement in OF Splices

The software makes it possible to measure attenuation in OF splices using the 5 marker method (figure 4.7)

To do it, place the markers near the splice in such a way that splice is located between the markers and the choose menu item **Mode → Splice**

**Loss** or press key **S** or press the  toolbar button.

At this time the sections of some length to the left of left marker and to the right of right marker are approximated with straight lines and attenuation in splice is calculated. All 5 markers can be moved regardless of each other or all together (see 4.3.4)

The approximation sections should have, if it is possible, maximal length and be uniform. The central marker should be set on the left end of a splice section.

The measurement results are displayed in the fourth and fifth table lines of the information panel:

**Spl, dB** – attenuation in splice,


**Spl, km** – distance from OF beginning prior to splice (to central marker).



Figure 4.7

#### 4.3.9 Reflectance Measurement

To measure reflectance from connection of two OFs or from the OF end, place the right marker on the peak of the reflected pulse and left marker – on the trace section right before it (**figure 4.8**).

Choose **Mode** → **Reflectance** or press the **R** key or press  toolbar button. The results of measurement are displayed in the fourth and fifth table lines of the information panel:

**Refl, dB** - reflection coefficient,

**Refl, km** - distance from OF beginning to the left marker.

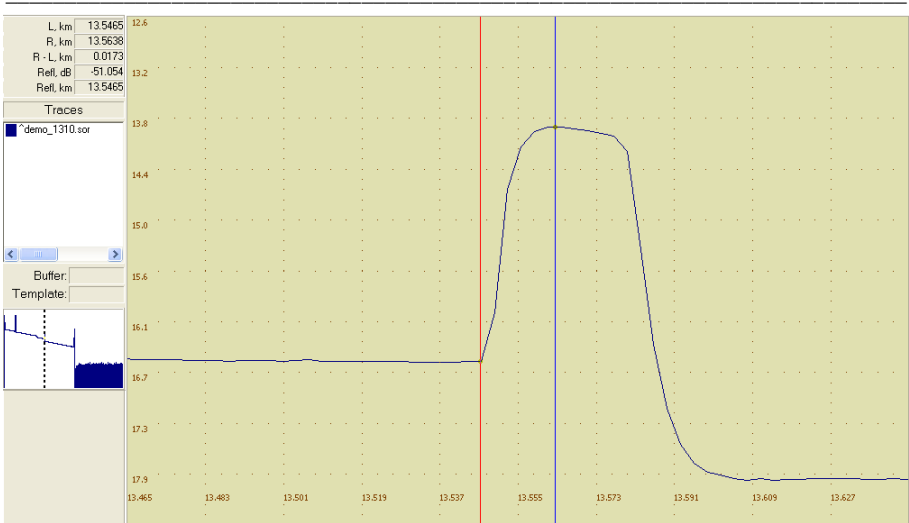


Figure 4.8

#### 4.3.10 ORL Measurement

**ORL** (optical return loss) – is a ratio (in dB) of the optical power introduced to OF and power returned to the OF beginning from the given section or the whole line.

To take an ORL measurement of an OF section or a whole line place the markers on the ends of the sections (**Figure 4.9**). Then press the **O** key, or choose the **Mode** → **ORL** menu item. The results of the ORL measurement are displayed in the fifth table line of the information panel.

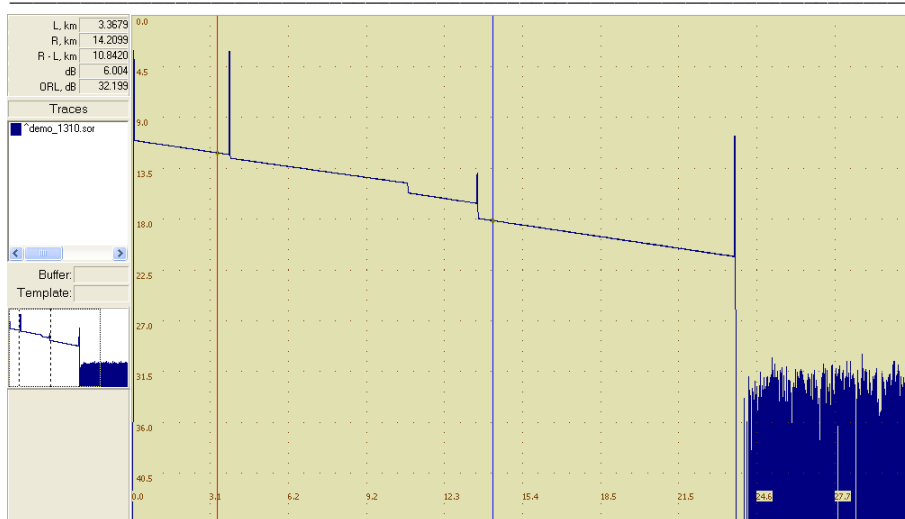


Figure 4.9

### 4.3.11 Automatic Trace Analysis

After ending the trace measurement process the managing programme automatically determines: the beginning and end of the line, the full line attenuation, the line ORL and enters this data into the Event Table (see 4.3.12).

For a more complete automatic trace analysis choose the menu item **Mode**

→ **Analysis** or press the **A** button or the **A** key. The managing program starts to search for events, attenuation or reflectance in which exceeds threshold values (see 4.3.12), calculates the distance to them and attenuation coefficient of sections between the events. This information is then entered into the Event Table and displayed as marks on the trace in case if the following options are chosen in the software: **Show Event Bar** or **Show Events Info on the Trace** (see 4.3.21).

It should be noted that in the long line when trace is distorted by noise, its automatic analysis may be inaccurate, e.g. OF splices with low attenuation may not be identified against the background of noise. These sections should be analyzed “manually” moving events, deleting incorrect ones and creating new ones as described in 4.3.13.

Threshold values at which automatic trace analysis has been performed are saved when saving the trace file. They can be read in the **Information** window (see **4.3.18**).

If you need to carry out automatic analysis of a previously saved trace with different threshold values, choose the menu item **Mode → Threshold...** The window (see **Figure 4.10**) will appear on the screen where you can enter new threshold values of the appropriate parameters.




**Figure 4.10**

**ATTENTION.** If the trace already has some marks, with starting the automatic analysis they are deleted.

### **4.3.12 Event Table**

**4.3.12.1** The program allows viewing all the events shown on the trace. To

do it, choose the menu item **Mode→Event table** or press the  button or the **T** key. The window containing two tabs (**figure 4.11**) will appear on the screen:

- with the list of event;
- with the list of sections marked by the user.

You may use the Comments field to enter notes. It is possible to enter a comment on each individual event.

The Event Table also contains the following data: **total (end-to-end) attenuation** and **ORL** of a line.

N#		Distance km	Reflectance dB	Splice loss dB	OF loss dB/km	Cumulative loss dB	
0	R	0.0000	-39.143				F
1	R	3.7747	-36.796	0.312	*0.333	1.257	F
2	S	10.8012		0.851	*0.316	3.789	F
3	R	13.5468	-51.047	1.316	*0.341	5.577	F
4	R	23.6836	-33.775	>6.000	*0.334	10.278	E

Comment:

End-to-end loss: 10.304 dB  
Optical return loss: 33.170 dB

Buttons: Delete, Markers, Move

**Figure 4.11**

The **Events** tab includes:

- the ordered number of the event;
- the type of event:

**R:** event with “reflection”, when event reflectance exceeds the threshold value regardless of attenuation in event;


**S:** event without “reflection”, when event attenuation exceeds and reflectance is below the corresponding threshold values;


- distance from OF beginning to the current event, km;
- event reflectance (if it exceeds the threshold value), dB;
- attenuation in event (if it exceeds the threshold value), dB;
- attenuation coefficient of a section between this event and the previous one, dB;
  - total attenuation of OF from its beginning up to the current event, dB;
  - event code in accordance with Table 4.3

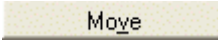

Select an event with the  $\uparrow$ ,  $\downarrow$  keys or by pressing left mouse button on the appropriate line of the **Event** tab. The chosen event is marked by color in the Event Table and by a red contour around the appropriate mark in the bottom part of a trace window (if the option **Show Marks** is chosen in the software settings - see **4.3.21**).

Event code	Meaning
A	Event added by the operator
M	Event moved by the operator
E	Event of the fiber end found at the automatic trace analysis
F	Event found at the automatic trace analysis
O	Event of the fiber 'end' at the automatic trace analysis when the length of the measured section is less than the total fiber length (L2 is less than OF length)
D	OF end mark moved by the operator

**Table 4.3**

**4.3.12.2** By pressing the  button for the chosen event in the trace window, you'll be able to see markers' positions at which the parameters of the given event were measured.

Press the  button to delete a event from the Event Table. It is impossible to delete the events of the beginning and end of a line.

When pressing  button, markers positions at which the parameters of the given event have been determined are displayed on the trace, and the **Event Move** window shown in **figure 4.12** appears on the screen. In this window use the  button to move the event location (central marker) or change the location of other markers. This allows correcting the parameters of the event received at the automatic or manual trace analysis. Only the left main and the left secondary markers for event of the **OF end** can be chosen in the **Event Move** window.

Only the right main and the right secondary markers for event of the **OF beginning** can be chosen in the **Event Move** window.

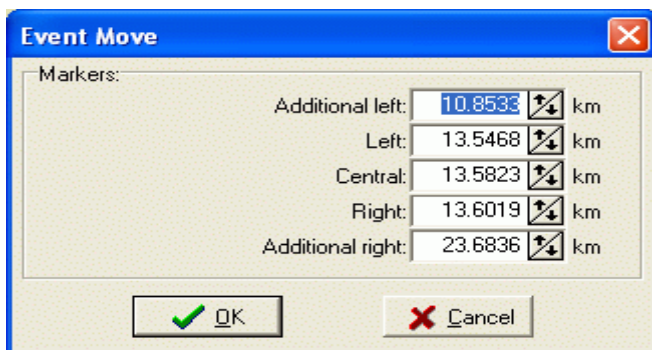


Figure 4.12

**4.3.12.3 Sections** tab of the Event Table (see **figure 4.13**) view section parameters, marked by the operator:

- section number;
- distance from OF beginning to the marked section, km;
- distance fro OF beginning to the end of the marked section, km;
- total attenuation of the marked section, dB;
- attenuation coefficient of the marked section, dB/km;
- section code as follows: **2P** - section attenuation was measured with 2PT method; **LS** - section attenuation was measured with LSA method.

№	Begin km	End km	Loss dB	OF loss dB/km	LS
1	0.5323	3.0166	0.828	*0.333	LS
2	5.3234	10.1144	1.514	*0.316	LS
3	11.2856	13.2375	0.667	*0.342	LS
4	13.8408	23.4228	3.205	*0.334	LS

Comment:

End-to-end loss: 10.304 dB  
Optical return loss: 33.170 dB

Buttons: Delete, Markers, Move

Figure 4.13

Select a section with the  $\uparrow$ ,  $\downarrow$  keys or by pressing left mouse button on the appropriate line of the **Section** tab. The chosen section is marked by color in the Event Table and by a red contour around the appropriate marks in the bottom part of a trace window (if the option **Show Marks** is chosen in the software settings - see 4.3.21).

**4.3.12.4** By pressing the  button for the chosen section in the trace window, you'll be able to see markers' positions at which the parameters of the given section were measured.

Press the  button to delete a section from the Event Table.

By pressing the button  for the chosen event in the trace window, you'll be able to see markers' positions at which the parameters of the given event were measured.

To delete one or several marks on the section, select it and press the  button.

### 4.3.13 Marks on the Trace

Depending on the program settings (see 4.3.21) the event symbols can be displayed in the bottom part of the trace window or (and) the marks with their numerical parameters can be displayed on the trace itself (Figure 4.14), namely:

- distance to the event in kilometers - a vertical legend below the mark without dimension;
- attenuation coefficient of the section, marked by the operator - a horizontal legend under the section, dB/km;
- attenuation coefficient of the section placed between the events - a horizontal legend above the section, dB/km;
- event reflectance (for event with reflection) and attenuation in dB, without the dimension - horizontal legends above the event.

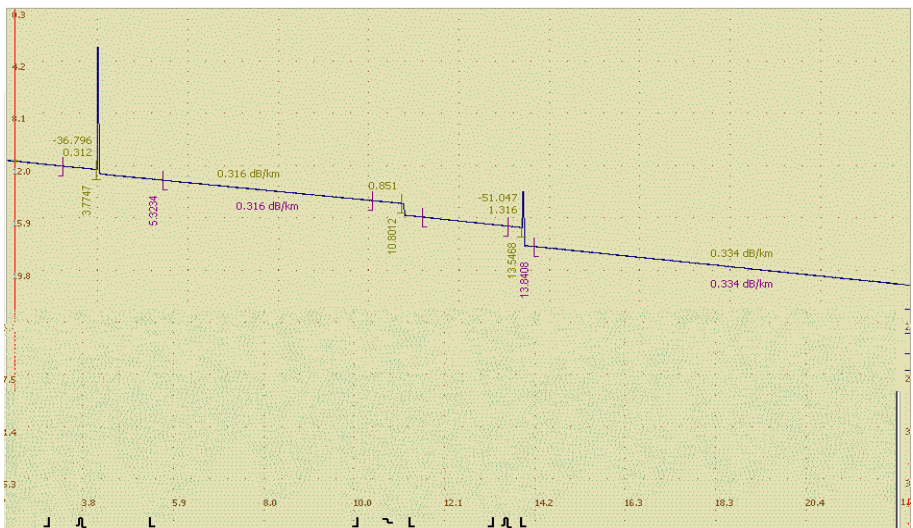



Figure 4.14

### 4.3.14 Operator Work at Events

**4.3.14.1** When working with a trace, the operator can delete or move events working with the Event Table as well as create new marks.

To create new event, it is necessary to select the corresponding

measurement mode, place the markers and press the  button, or the **CTRL+ENTER** keys or choose the menu item **Mode → Insert Marks**.

When you do it the event will be fixed, marked on the trace and entered into the Event Table.:



If **2PT** attenuation measurement mode is used (see **4.3.6**), the markers location is fixed on a trace and section parameters are entered into the **Sections** tab with the section code specified **2P**.

If **LSA** attenuation measurement mode is used (see **4.3.7**), the markers location is fixed on the trace and section parameters are entered into the **Sections** tab with the section code specified as **LS**;

While measuring OF splice attenuation (see **4.3.8**) the location of the central marker is fixed on the trace, parameters of the marked event are entered into the **Events** tab of the Event Table; the software also automatically calculates reflectance value in the event and it is entered into the Event Table if the reflectance exceeds the threshold value.

While measuring the reflectance (see **4.3.9**) the location of the left marker is fixed on a trace, parameters of the marked event are entered into the **Events** tab of the Event Table; the software also automatically calculates attenuation in event and it is entered into the Event Table.

**4.3.14.2** To remove even(s), place the markers in such a way that the even(s) you want to delete is located between the markers, and press the

 button, or **ALT+DEL** key, or choose the menu item **Mode → Delete marks** or select an event or a section in the Event Table and press the  button.

*ATTENTION. The events that were moved or created by the operator are deleted at the subsequent launch of the automatic trace analysis.*

The marked OF parameters are displayed when printing a trace and saved when the trace is saved on a disk.

### 4.3.15 'Template' Function

For fast analysis and documentation of a built multifiber optical line having a lot of events 'Template' function is used. With its help the operator can transfer events marked on one optical fibers of the line to the other fibers.

In order to use the 'Template' function, first, create a template, i.e. save the data on the events location of one trace and then apply them to the other trace, namely, to transfer the marks onto it.

To do this, follow the procedure:

- create events on any OF in manual (see 4.3.14) or automatic (see 4.3.11) modes;

- choose the menu item **Compare→ Create template** or press the



button to save the template in PC's memory, i.e. to save information on spatial location of events. The file name will be

displayed in the **Template** window of the information panel. The button becomes active, as do the menu items **Compare→ Apply template** and **Compare→ Delete template**;



- go to another window with a similar trace;

- press the  button or **CTRL+T** keys or choose the menu item **Compare→ Apply template**.

The marks on the second trace will appear which will characterize it on the same sections and places, as on the first trace, i.e. according to the 'template'. The attenuation values will correspond to the second trace.

*ATTENTION. If there were marks on the second trace before applying the template, those marks will now be deleted.*


On the trace after the events have been created in accordance with the template, it is possible to create additional events or delete any events, as described in 4.3.14.


To create a new template repeat the actions described above. The previous template is deleted from the PC buffer memory and is replaced by the new one.

To delete the last template use the menu item **Compare→ Delete template**.

### 4.3.16 Trace Filtration

The programme provides the possibility to use a smoothing digital filter to the measured trace.

To perform filtration, choose the menu item **Mode→Filter** or press the  button or press the **F** key.


To cancel filtration, press the  button or the **F** key again.  
Filtering degree is dependent on optical probe pulsewidth.


### 4.3.17 Traces Comparison

**4.3.17.1** Each newly measured (opened) trace is displayed in a separate window. However it is possible to insert several traces into one window for comparison.

To insert (paste) a trace in the current window from another window:

- go to another window;

- press the  button or the **CTRL+INS** keys or choose the menu item **Compare → Copy trace**. The trace will be stored in the buffer memory; the name of the copied file trace will be shown in the **Buffer** window of the

information panel.  button becomes active as does the menu item **Compare → Paste trace** (if the trace paste was not carried out before);

- go to the current window where you need to insert the trace;

- press the  button or **SHIFT+INS** keys or choose the menu item **Compare → Paste trace**.

An inserted trace will appear now displaying in the current window.

**4.3.17.2** In the **Traces** list of the information panel (**Figure 4.15**), the inserted trace's name will be added (basic trace name always appears first). You may insert up to seven traces in the current window.

The attenuation and length measurement can be carried out only on one of the traces in the window, namely, on the **active** trace.


The active trace's name has a symbol "**^**" next to it in the **Traces** list.

To make the trace active, double-click on its name in the list or press **CTRL+SPACE** keys.

Use **PAGE UP/DOWN** to move to the previous or the following trace on the list.

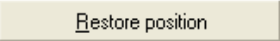


**Figure 4.15**

**4.3.17.3** To delete the inserted trace from a window, choose its name in the trace list and press the  button or **CTRL+DEL** keys or choose the menu item **Compare → Delete trace**.

**4.3.17.4** You may shift the traces in the window vertically. To do it, make the trace active and choose the menu item **Compare → Shift Trace**. The

window (figure 4.16) will appear. Use   buttons or **Shift + ↑** and **Shift + ↓** **up** keys to move the traces. The button OK fixes the new trace location.

Button  returns the inserted trace to its original position.

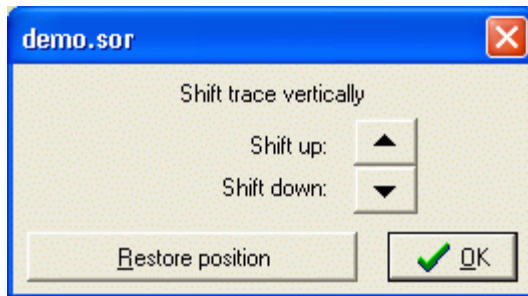


Figure 4.16

**4.3.17.5** The program makes it possible to insert (paste) several traces into one window using an other method – quick paste.

To insert traces into the current window from other windows choose the menu item **Compare → Quick Paste** or press the **Z** key. In the window that will appear (**figure 4.17**) choose the traces that you need to paste to the current window. To do that click the mouse left button into the square box next to the file name. After that the symbol  $\checkmark$  appears in the box and corresponding trace in the window.


The file name selection can also be carried out by the  $\uparrow$  and  $\downarrow$  keys and pressing the **Spacebar**.

Press the **ENTER** key or the  button to close the **Quick Paste** window.



Figure 4.17

### 4.3.18 Trace Description

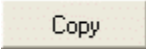

Each trace is supplied with the explanatory information. To enter and read this information press the  button or the **I** key or to choose the menu item **Mode → Trace info...**

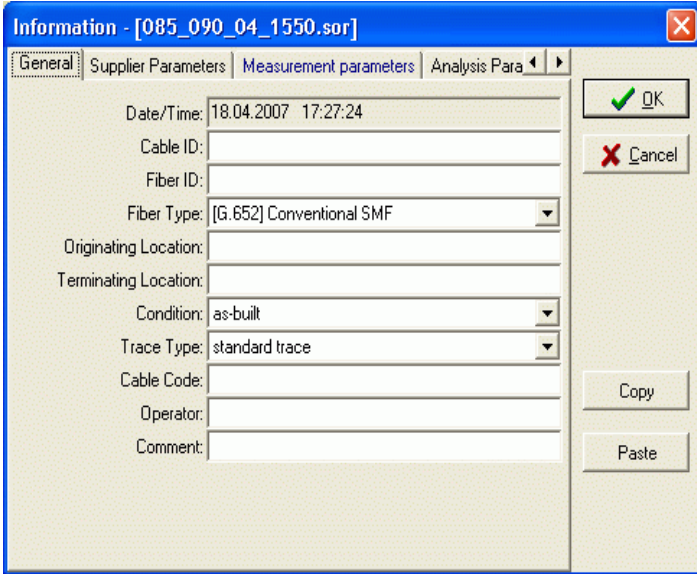
The window shown **Figure 4.18** appears. It contains the information on a trace on four tabs.

**a./ Information tab (Figure 4.18).**

In the tab fields measurement object characteristics can be specified, entered or selected.

The information of this tab can be copied and paste into the appropriate window of another trace. For this purpose the

 and  buttons are used.



Information - [085\_090\_04\_1550.sor]

General | Supplier Parameters | Measurement parameters | Analysis Para

Date/Time: 18.04.2007 17:27:24

Cable ID:

Fiber ID:

Fiber Type: [G.652] Conventional SMF

Originating Location:

Terminating Location:

Condition: as-built

Trace Type: standard trace

Cable Code:

Operator:

Comment:

OK

Cancel

Copy

Paste

**Figure 4.18**

b./ **Supplier Parameters** tab (Figure 4.19).

Information on the instrument and the OTDR module with which the trace is measured are given here. The lines in this window are inaccessible for change.

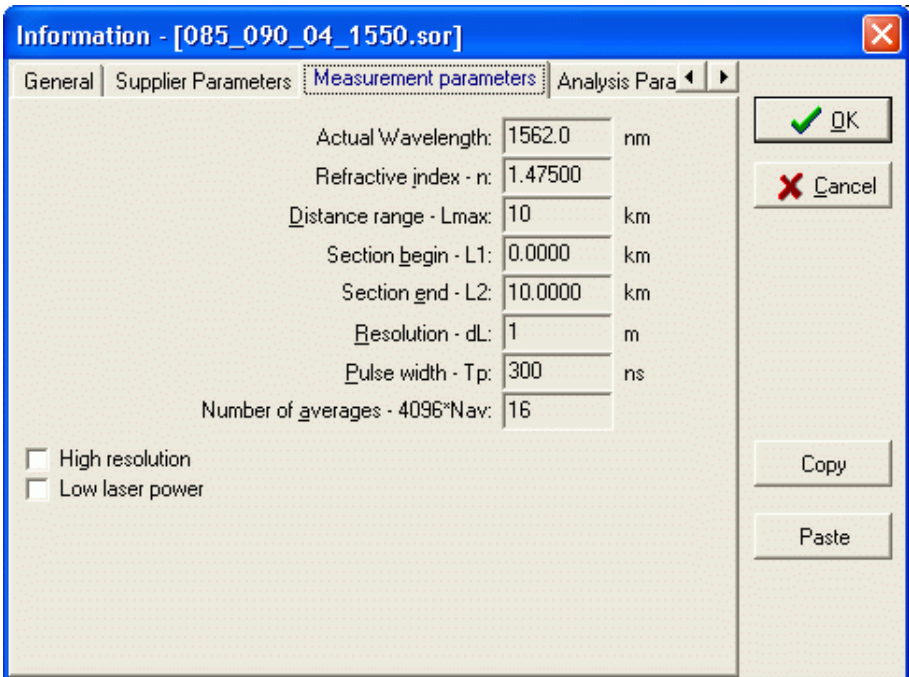


**Figure 4.19**

**c./ Measurement parameters** tab (Figure 4.20).

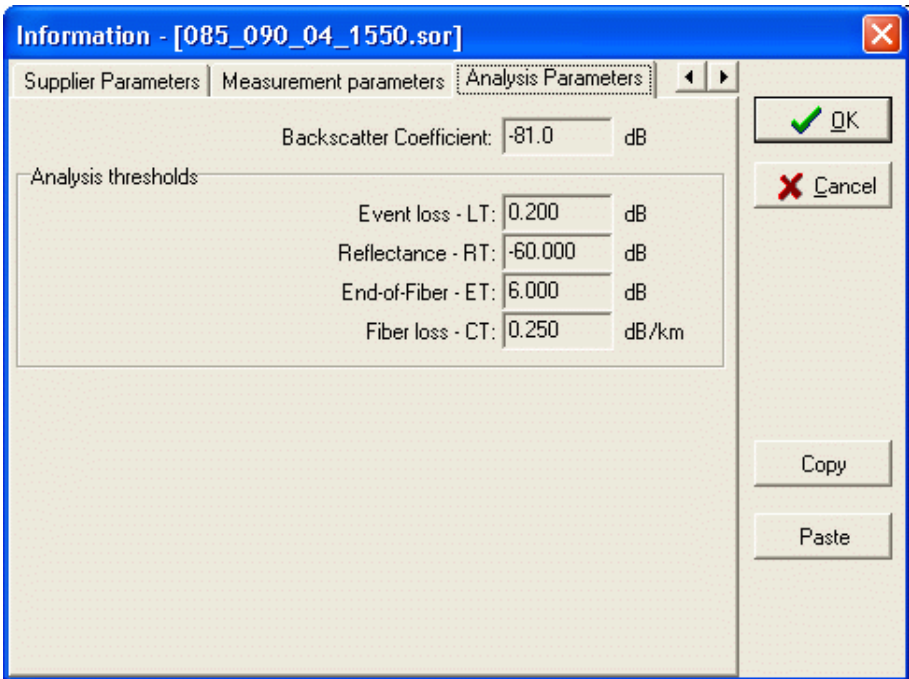
Measuring parameters of the given trace which were set by the user before the start of measurement are given here. In the line “Actual Wavelength” the software enters the exact wavelength value of the laser diode set in the given measurement module.

The lines in this window are inaccessible for change.

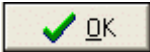
**Figure 4.20**

**d./ Analysis Parameters** tab (Figure 4.21).


The threshold values used at the automatic trace analysis are displayed here.




**Figure 4.21**

Press the  button or **ENTER** key to save the entered information.

This also saves the description in a file.

Pressing the  button or the **Esc** key cancels all the changes made by the operator.


### 4.3.19 Saving Traces

To save a trace press the  button or choose the menu item **File**→**Save**. Trace can be stored in Bellcore format, versions 1.0, 1.1, 2.0.

When storing traces, it is possible to use the mode of auto-numbering of file names. If this mode is activated (see 4.3.21), the symbols "**\_xx**", where **xx** is a number, would be added to the file name entered initially by the user. The value **xx** goes up with each new saved trace.

The trace report can be saved in the form of a **.pdf** or **.rtf** file (\*). To do it, choose the menu item **File** → **Save the report as** and save the report in the required form.

### 4.3.20 Printing Traces

To print a trace, select **File** → **Print** or press  button on the toolbar. Before printing preview function **File** → **Print Preview** is available.

By default the report is generated in the format preset in the software. The operator (a qualified PC user) can change the form and contents of the report. To do that (see 4.3.21):

- choose the menu item **Setup**→**Preferences...**;
- in the tab General choose the Use extended print;
- then choose the required (created beforehand) setup file.

The report is then created in accordance with this setup file. The format of report setup file is described in the Supplement B.

### 4.3.21 Software Set-up

4.3.21.1 During the work the user can set up the software with the **Setup → Parameters** menu item. The **Preference** window includes four tabs.

a./ **General** (Figure 4.22)

On this tab the user can:

- select a unit of length measurement;
- user interface language;
- switch on auto numbering of files (see 4.3.19);
- switch on a mode of the **Save as** extended dialogue;
- switch on a mode of a color printing;
- switch on a mode of the extended printing and choose the report setup file.

And also to select options:

- to apply the filter to new traces;
- to apply automatic analysis to new traces;
- to copy the trace information when applying a template;
- to apply **ZOOM** mode when new measurement is started ;
- maximize a window with a trace by opening, if it is the only one.

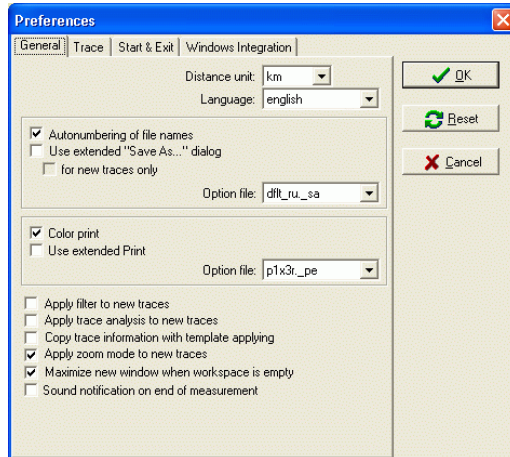
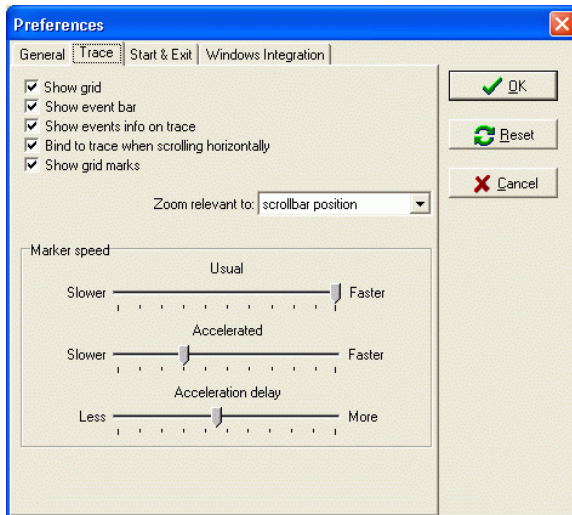


Figure 4.22

**b./ Trace tab (Figure 4.23).**

On this tab the user can establish the following options:

- to draw a scale grid in a window with a trace;
  - to display the panel with marks in the bottom part of a trace window (see **4.3.13**);
  - to display event information on the trace (see **4.3.13**);
  - to bind the trace to the window vertical center when the it is scrolled horizontally
- 
- to select scale zoom mode relative to
    - left window border;
    - right window border;
    - center of the widow;
    - location of the scrollll box.
  - to set a speed of markers moving in a window with a trace in various modes.

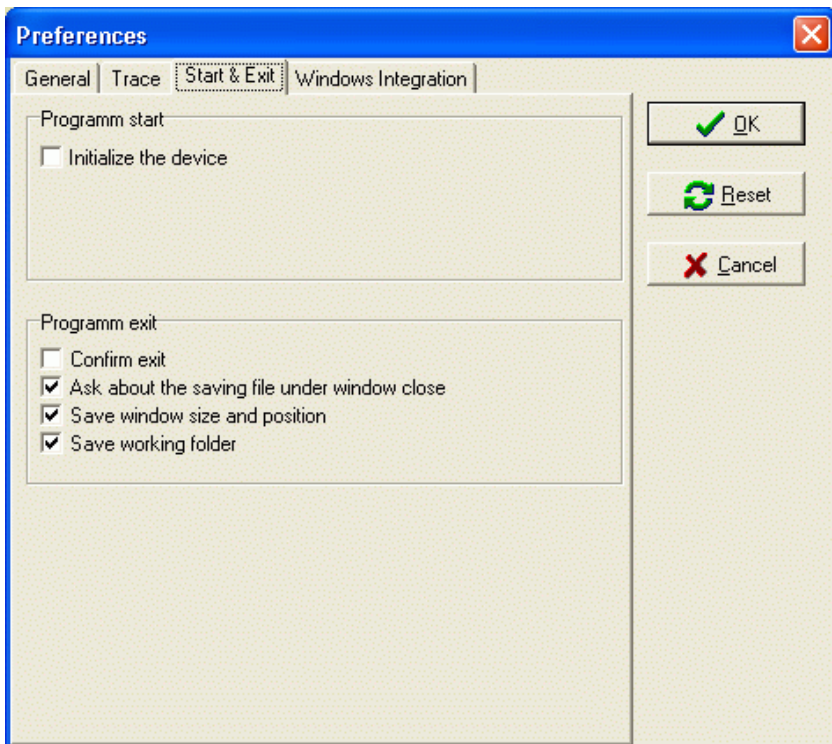


**Figure 4.23**

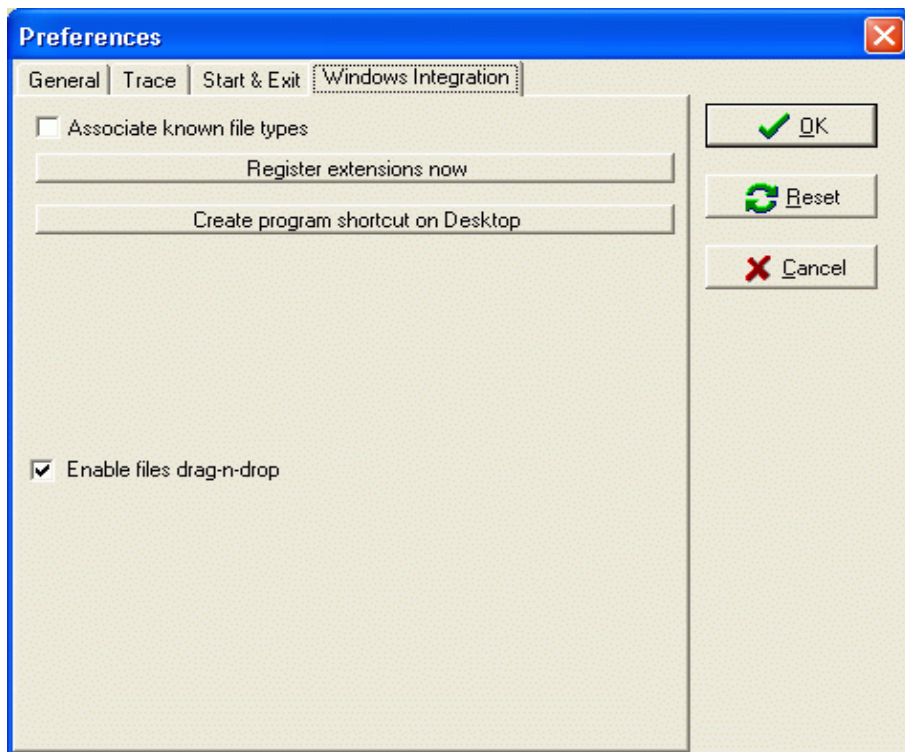
**c./ Start & Exit tab (Figure 4.24)**

On this tab the user can activate the following options:

- automatically check the device connection when starting the programme (if this option is not activated, the testing of the connection of the device to the PC takes place when you open the **Measurement Parameters** window);
- to confirm exit from the program;
- to request about file saving when closing a window with a trace;
- to remember the size and location of the software main window at the end of work;
- to remember last working catalogue.



**Figure 4.24**


**d./ Windows Integration** (Figure 4.25)**Figure 4.25**


On this tab the user can set the following options


- to register known types of files at software start;
- to permit dragging files to a software window (mode drag-n-drop).

Also by pressing the appropriate buttons the user can register known types of files and create a shortcut of the program on desktop.

Having finished the appropriate set-up of the software, press the

 button.

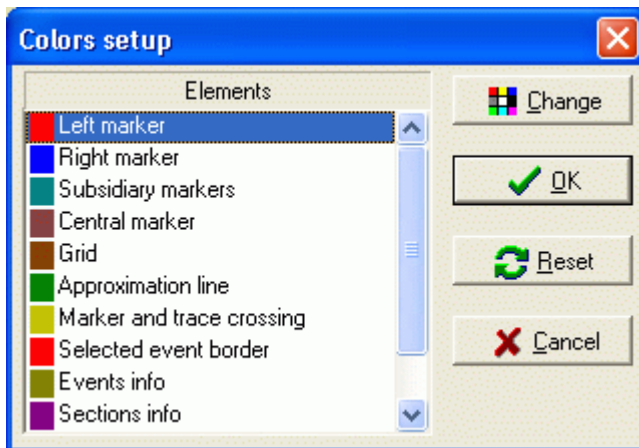
By pressing the  button, you cancel all the changes you have made in the software set-up.

By pressing the  button you return the settings to the status, provided by the developers (by default).

On **Figures 4.22 – 4.25** you can see the settings by default.


**4.3.21.1** To provide greater comfort when working with the software, the user has the opportunity to set up the color palette used when displaying various elements.

To do this selects **Setup → Colors...** dialog box. As shown in figure **4.26** a window will appear displaying the list of different elements and corresponding colors.




**Figure 4.26**


To change element color, select element needed by double clicking the


mouse or by the  button or by using **↑,↓** keys and **SPACE** pressing,

A standard window will appear. Select the color you wish and press

 button.

Having done all the necessary changes press  button to confirm the changes.

To cancel the changes press the  button.

By pressing the  button you return the settings to the status, provided by the developers (by default).

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## NOTES