

User's guide

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1、 Copyright Information

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Measurement unit

The measurement unit used by the manual complies with SI standard and conventions.

2. Safety Information

Safety Instruction

When using the product, pay attention to the following safety measures. Any behavior not adopting these safe operation methods or not complying with special cautions stated at other places of the manual will violate the safe designing, manufacturing and using standard of the products. ORIENTEK Optical Technology Ltd.(www.orientekot.com) won't undertake any responsibility for the consequences caused by customers violating these requirements.

- **Working Environment**

Maximum relative humidity 95%, temperature 0°C ~ +50°C.

- **Before connecting to the power**

Confirm that the product is set to the matched voltage, is installed with proper safety components and is adopted with all safety measures.

- **Product use**

Please do not during charging boot using the product.

- **Do not operate in explosive environment**

Do not use the product when inflammable gas or smog existing.

- **Do not dismantle the protection sheath of the instrument**

Operators couldn't dismantle the sheath of instrument or change interior components. If need, please contact the maintenance personnel of our company.

Safety Terms of the Manual



Warning symbol indicates danger existed. It informs users pay attention to a certain process, a certain operation method or similar conditions. If operate wrongly or violate rules, bodily injury may occur. Do not enter into the next step before fully understanding and meeting the indicated warning conditions.



Be careful symbol indicates danger existed. It informs users pay attention to a certain process, a certain operation method or similar conditions. If operate wrongly or violate rules, partial or fully damage or defacement may occur to the instrument. Do not enter into the next step before fully understanding and meeting the indicated careful conditions.



Indication symbol gives you helpful information about instrument operation and maintenance.

Warning Matters



Optical time-domain reflectometer is laser equipment. Users should avoid look steadily at the laser outlet from time to time, also couldn't observe the optical source outlet with microscope or magnifier, etc. If the energy of laser beam focuses on the retina, the eyes will be hurt perpetually.

When using our OTDR to measure optical fiber, working light in the measured optical fiber couldn't exist. Otherwise, the measuring result won't be accurate, and the instrument may be damaged perpetually.

Cautions



Battery: the battery of our company's optical time-domain reflectometer adopts rechargeable lithium battery. When using the instrument after a long term lying aside, charge the battery firstly. If the instrument is laid aside for more than 1 month, charge the battery in time to maintain the electricity in the battery. Do not charge the battery over 8 hours. Do not take out the battery randomly. Do not make the battery approach to fire and heat-flash. Do not open or damage the battery. Do not touch the electrolyte of the battery, otherwise the eye, skin and clothes will be injured and corroded.

Avoid laser radiation: during measuring processing of optical fiber system, avoid looking at the open optical fiber, optical fiber interface, optical fiber tie point and other optical source, etc; otherwise, the eyes may come into contact with the transferred laser and be hurt.

- When the optical time-domain reflectometer working, do not look at the laser outlet directly;
- After using, cover the dust cap onto the optical outlet of the optical time-domain reflectometer;
- Do not directly look at the disconnected terminal of the being tested optical fiber. If possible, make the disconnected terminal of fiber optical point to a non-reflective object.

3、 Introduction to OTDR

3.1、 Measuring Purpose of OTDR

OTDR displays the power of the returned signal related to distance. The information can be used to confirm the transmission quality of a fiber optic link.

3.1.1、 Measuring Contents of OTDR

- Position (distance) of event, result or fractured position of fiber optic link;
- Attenuation coefficient of optical fiber in the optical fiber link;
- Loss of a single event (for example, a optical connector or bending), or total losses from end to end on the fiber optic link;
- Reflection amplitude (or reflection level) of an event, such as connector

3.1.2、 OTDR Curve Analysis

OTDR analyzes the curve automatically. Location of the curve:

- Reflection event generated from connection and mechanical connector;
- Non-reflection event (usually be fusion splice);
- Optical fiber bundling: through scanning the first loss event that larger than the bundling threshold, OTDR detects the bundling of optical fiber;
- Events list: Category of events, loss, reflection, and distance are listed through calculation.

3.2、 Basic Principle of OTDR

Optical Time Domain Reflectometer is the full name of OTDR. OTDR is accurate optoelectronic integrated instrument made according to back scattering that generated from Rayleigh scattering and Fresnel reflection when lights are transmitted in the optical fiber. It is widely used in the maintenance, construction and monitoring of cable line. It can measure the optical fiber length, transmission attenuation of optical fiber, attenuation of splice, and failure location, etc.

When the pulse being transmitted downwards along with the optical fiber, and some small changes (such as changes of refractivity and discontinuity) in the material make the lights scatter to different directions, Rayleigh scattering occurs. Partial lights are scattered back along with the direction that opposite to pulse, therefore, it is called Rayleigh back scattering. Back scattering light shows attenuation details that related to the length. Information related to length is gained through time (i.e.: origin of domain of Optical Time Domain Reflectometer). These back scattering signal indicates the attenuation (loss/distance) degree caused by optical fiber. The curve formed is a downwards curve, which reflects the transmission characteristics of the optical fiber.

When lights transmitted downwards along with the optical fiber encountering sudden change of material density, Fresnel reflection occurs. Material density change may occur at the connection or fracture parts where air gap existed. This phenomenon is used by OTDR to accurately confirm the position of discontinuity point along with the length of optical fiber. Compared to Rayleigh scattering, Fresnel reflection will reflect quite a lot of lights. The power of Fresnel reflection is tens of thousands times of that of back scattering. The reflection strength is ascertained according to the change degree of refractivity.

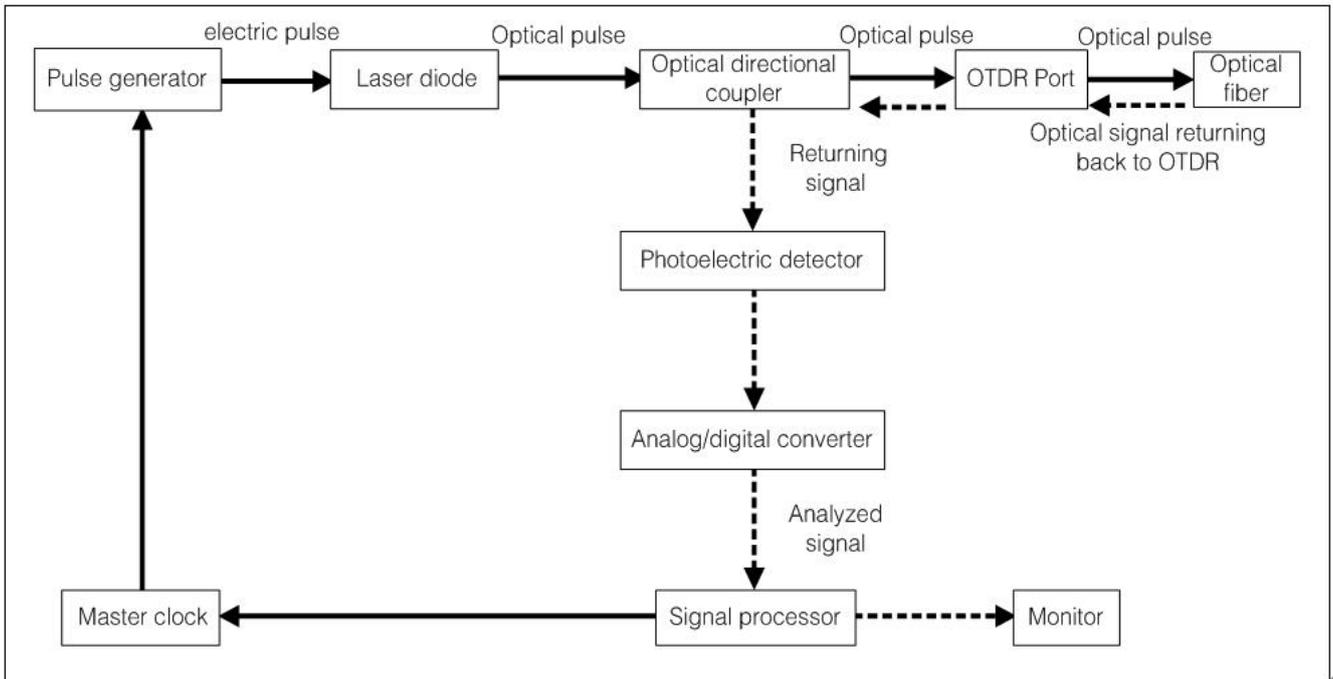
Distance calculation formula of OTDR: $\text{Distance} = (c/n) \times (t/2)$

Among which: c = speed of light in vacuum (2.998×10^8 m/s)

t = Time delay between transmitted pulse and received pulse

n = refractivity of optical fiber during testing process (nominated by manufacturer)

When displaying the whole trace, each point on the trace graph represents the average value of several sampling points. The value of each sampling point can be found by reducing or magnifying the trace.



3.3. Instruction of Events Categories

Events on optical fiber indicate these abnormal points that brought loss or sudden change of reflection power beyond normal scattering of optical fiber material, including various kinds of connection and bending, loss of flaw or fracture on the optical fiber link.

Event points displayed on the screen is the abnormal points in the optical fiber that led to deviation of trace, which are classified with special symbols on the trace.

Events include "reflection event" and "non-reflection event" .

3.3.1. Initial Event

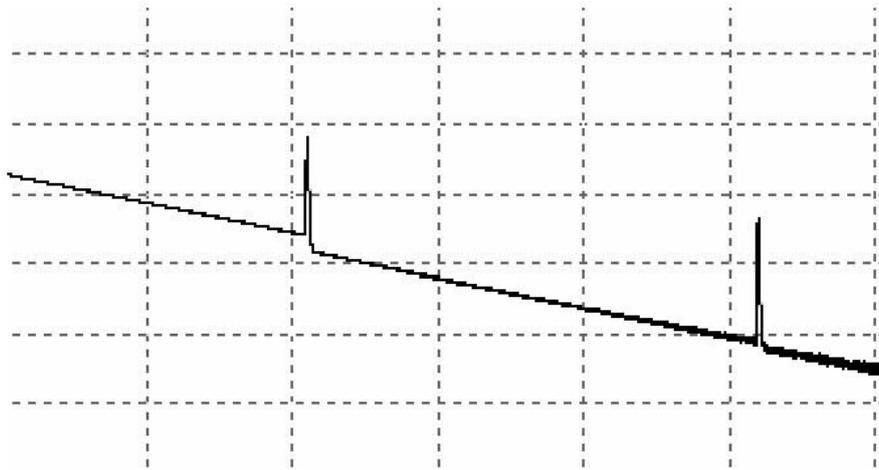
"Initial event" on the OTDR trace is the event that marks the starting point of optical fiber. Under default conditions, "initial event" is located at the first event (usually be the first connector of OTDR) of the tested optical fiber. The event belongs to reflection event.

3.3.2. End Event

"End event" on the OTDR trace is the event that marks the terminal of optical fiber. Under default conditions, "end event" is located at the last event of the tested optical fiber. The event is called optical fiber terminal event (usually be the end or fracture point of the tested optical fiber), which usually belongs to reflection event.

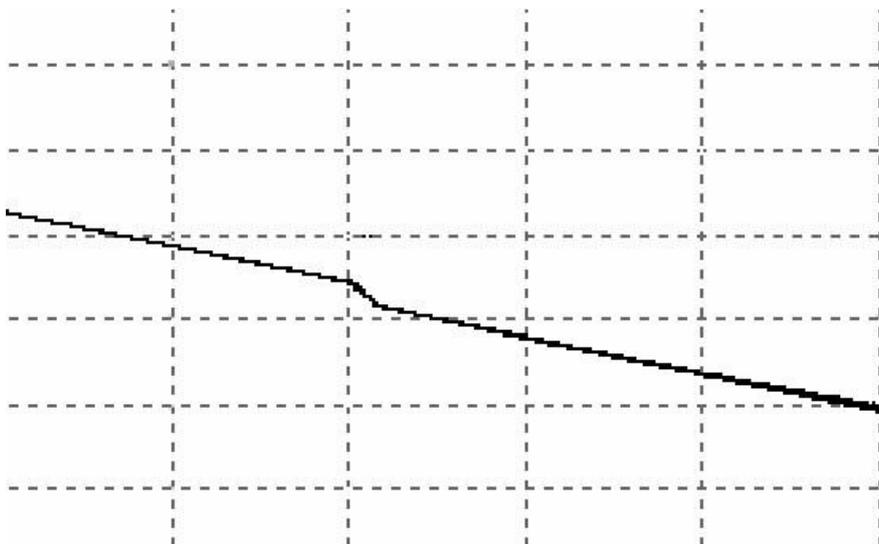
3.3.3. Reflection Event

When optical pulse energy is reflected (such as on the connector), reflection event occurs. On the trace, reflection event is shown as peak signal, as shown in Fig.



3.3.4. Non-reflection Event

Non-reflection event brings loss on the whole transmission link of optical fiber, but no light reflection. On the curve, non-reflection event is shown as drop of optical power, as shown in Fig.



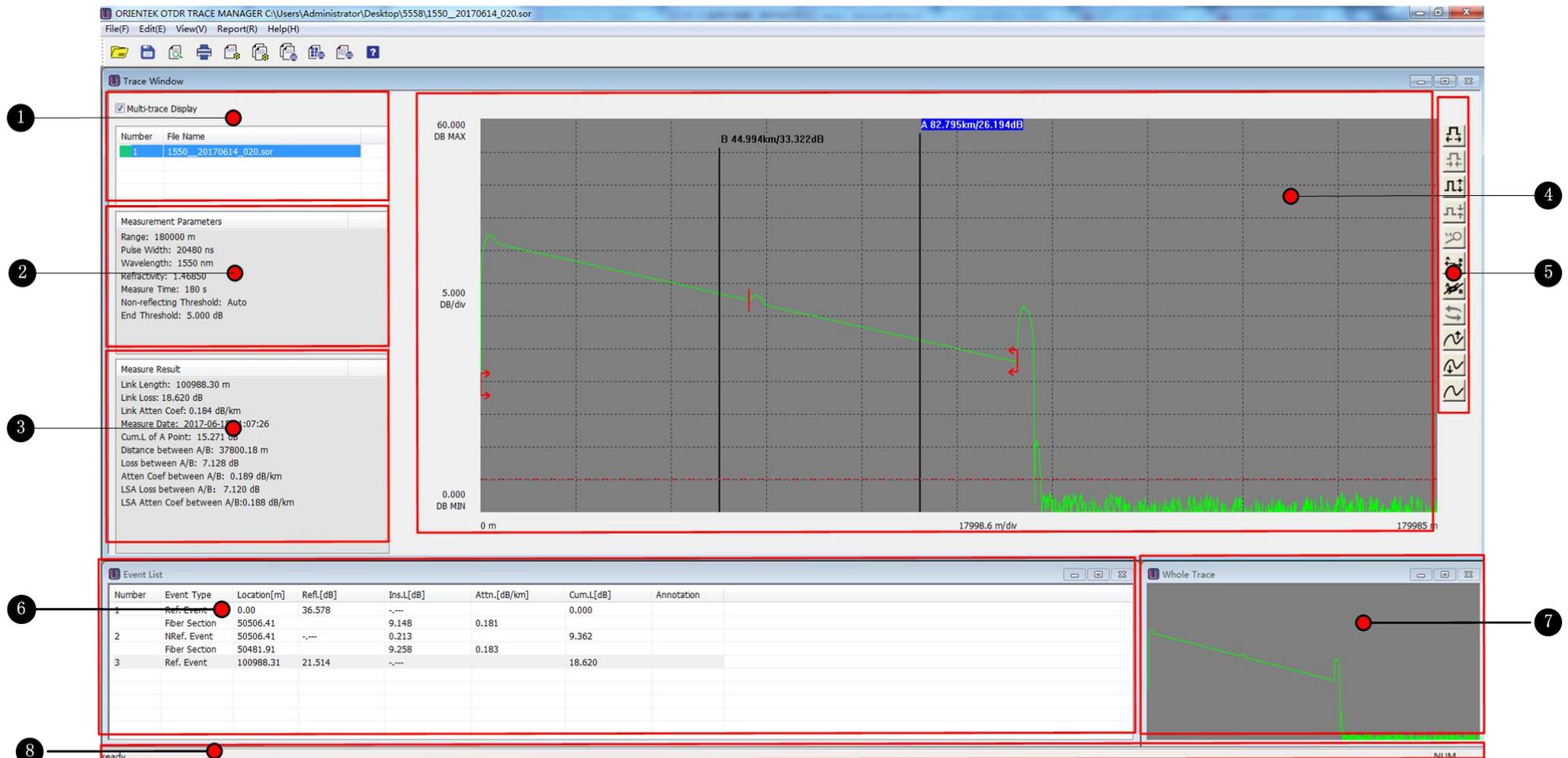
3.3.5. Event Inspection

OTDR sends optical pulse into the optical fiber that waited for inspection, then, begins to accept the returned optical signal immediately, and calculate the distance of "event" in the optical fiber. The further the event is, the longer the time for returning back to OTDR will be. The distance can be calculated according to the time when receiving the event.

Through inspecting the curve of the reflected signal, the optical transmission characteristics of optical fiber, connector and joint can be confirmed.

4. Screen

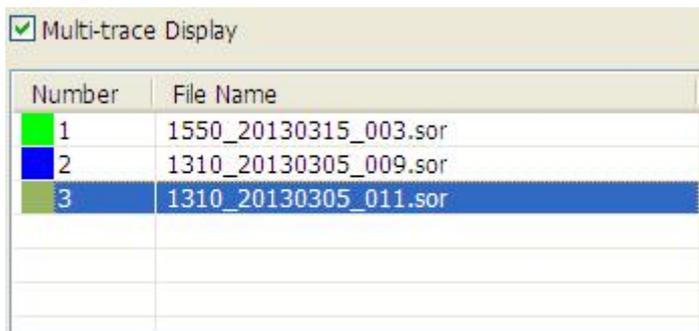
The following is the description of the OTDR PC software screen display interface, as shown in the following picture.



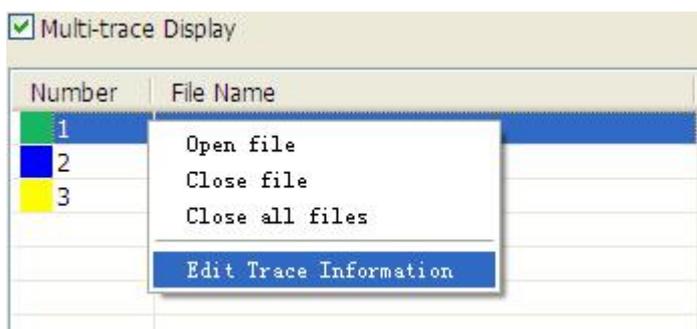
- | | | | |
|----------------------------------|---|--|----------------------------------|
| 1. the display zone of file list | 2.the display zone of measurement parameter | 3.the display zone of measurement result | 4.the display zone of waveform |
| 5.the display zone of toolbar | 6.the display zone of event list | 7. the display zone of Thumbnail | 8.the display zone of status bar |

4.1. The display zone of file list

“The display zone of file list” display the current downloading wave file which be lighten. At the same time, the display of multi-waves provide switch-over display between single wave and multi-waves in display zone of waveform.

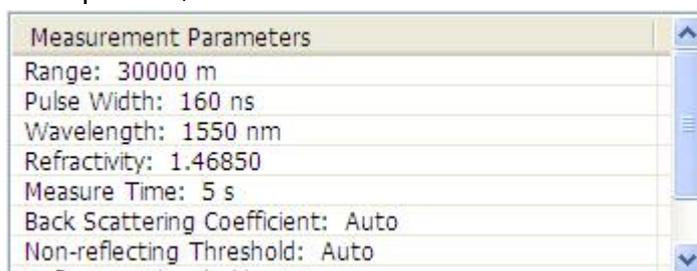


The four operations like “open the file,” “close all files”, and “edit trace information” can be operated button clicking right mouse. Clicking the button of “open the file” open the chosen wave files by directory, then the file will be tacitly approved current files. To click “close the file” is to close the current file in the wave display zone”. To click “close all files” is to close all files in the display zone of file list and display zone of wave pattern. To click “edit the trace information” is to edit the trace information if modified current files.



4.2. The display zone of measurement parameter

“The display zone of measurement parameter” display the measurement parameter of chosen wave file: range of distance, pulse width, optical maser wavelength, refractive index, the duration of measurement, coefficient of dispersion, end threshold and so on.



4.3. the display zone of measurement result

“The display zone of measurement result” display measurement result information of currently chosen wave files: chain length, chain lost, chain attenuation coefficient, the number of events, the data of measurement, Point A cumulative loss, the distance between Point A and Point B, the attenuation with the distance between A and B, the LSA attenuation of distance between A and B.

Measure Result
Link Length: 22637.04 m
Link Loss: 5.881 dB
Link Atten Coef: 0.260 dB/km
Event Number: 3
Measure Date: 2017-07-14 14:55:57
Cum.L of A Point: 0.545 dB
Distance between A/B: 3273.53 m
Loss between A/B: 0.622 dB
Atten Coef between A/B: 0.190 dB/km
LSA Loss between A/B: 0.634 dB
LSA Atten Coef between A/B: 0.194 dB/km

4.4. The display zone of waveform

"The display zone of waveform" display at most eight wave files, it can switch-over between the single wave and multi-wave in the display zone of wave.

4.5. The display zone of toolbar

"The display zone of toolbar" display all function key in all kinds of tools. Just one key can run within different operating situation.

No.	Button	Name	Function
1		H zoom in	The later magnification is operated by the intersection of the chosen market post and measure wave.
2		H zoom out	The later shrink is operated by the intersection of the chosen market post and measure wave.
3		V zoom in	The longitudinal magnification is operated by the intersection of the chosen post and measure wave.
4		V zoom out	The longitudinal narrow is operated by the intersection of the chosen post and measure wave.
5		Switch AB	It indicates the AB staff can switch-over in the current conditions.
6		Switch trace	It indicates at least two measure waves can switch-over in the current condition.
7		AB lock/unlock	It indicates the AB staff's lock and unlock with corresponding location.
8		Reset trace	It indicates the 1:1 restoration of measure wave.
9		Trace Up	It indicates the current wave can up-shift when display the multi-wave.
10		Trace Down	It indicates the current wave can down-move when displaying the multi-wave.

4.6. The display of event list

"The display of event list" display the particular information of current wave files: The number of events, the types of events, the location of events, the return loss, insert loss, attenuation coefficient, cumulative loss. If any event information exist, its display is blank.

To click the right mouse can edit the running chosen event, like add/modify/cancel events.

Number	Event Type	Location[m]	Refl.[dB]	Ins.L[dB]	Attn.[dB/km]	Cum.L[dB]	Annotation
1	Ref. Event	0.00	36.578	-.---		0.000	
	Fiber Section	50506.41		9.148	0.181		
2	NRef. Event	50506.41	-.---	0.213		9.362	
	Fiber Section	50481.91		9.258	0.183		
3	Ref. Event	100988.31	21.514	-.---		18.620	

4.7. The display zone of Thumbnail

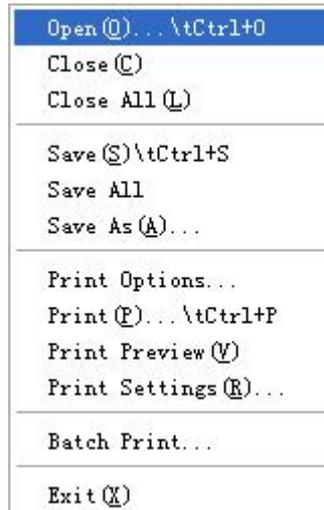
The display zone of Thumbnail can display completely current waves. It also can show the part of current waves in rectangular box, at the same time it displays the location of cursor in the wave.

4.8. The display zone of status bar

The display zone of status bar display the current status.

5、 File menu

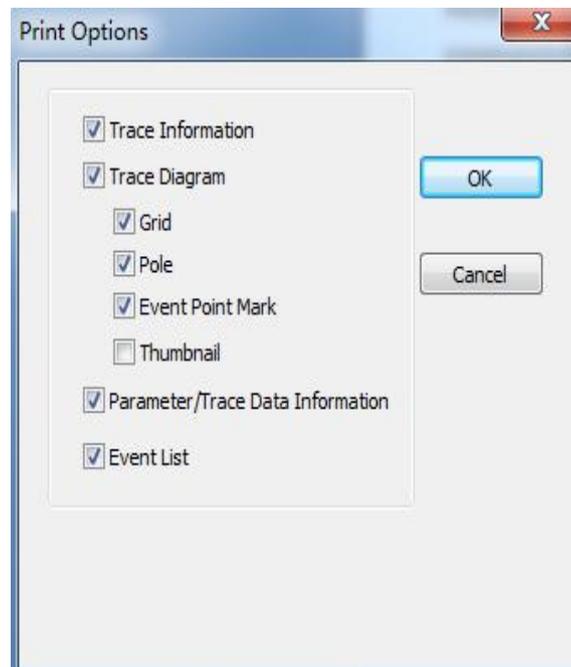
The functions like “open, close, save, save -as, print-setting, print, bulk print, run in the files menu.



After choosing the function of “open files”, it will pop up “open the dialog box”, it runs the function of choosing no more than eight wave files within the same folder file by “Ctrl+mouse”; The chosen files the same folder file by “Ctrl+mouse”; The chosen files are added to file list of “multi-waves” display. The opened wave files execute “close” operation by choosing the menu “file” to choose “close the file” or “close all files”.

There are three different demands for reserving the wave files like save modified wave files, save all modified wave files, save-as wave files. The function like print option, print, print preview” follow the corresponding print made of “single page with single wave”.

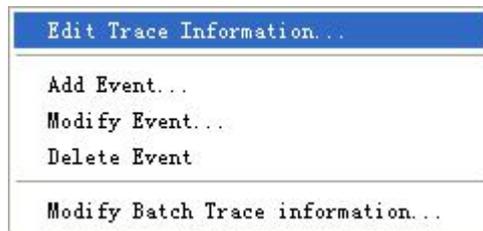
The setting project of “print option”: trace information, trace chart,(including internet, sigh post, thumbnail), parameter/trace data information,event list, the windows default can select all expect thumbnail.



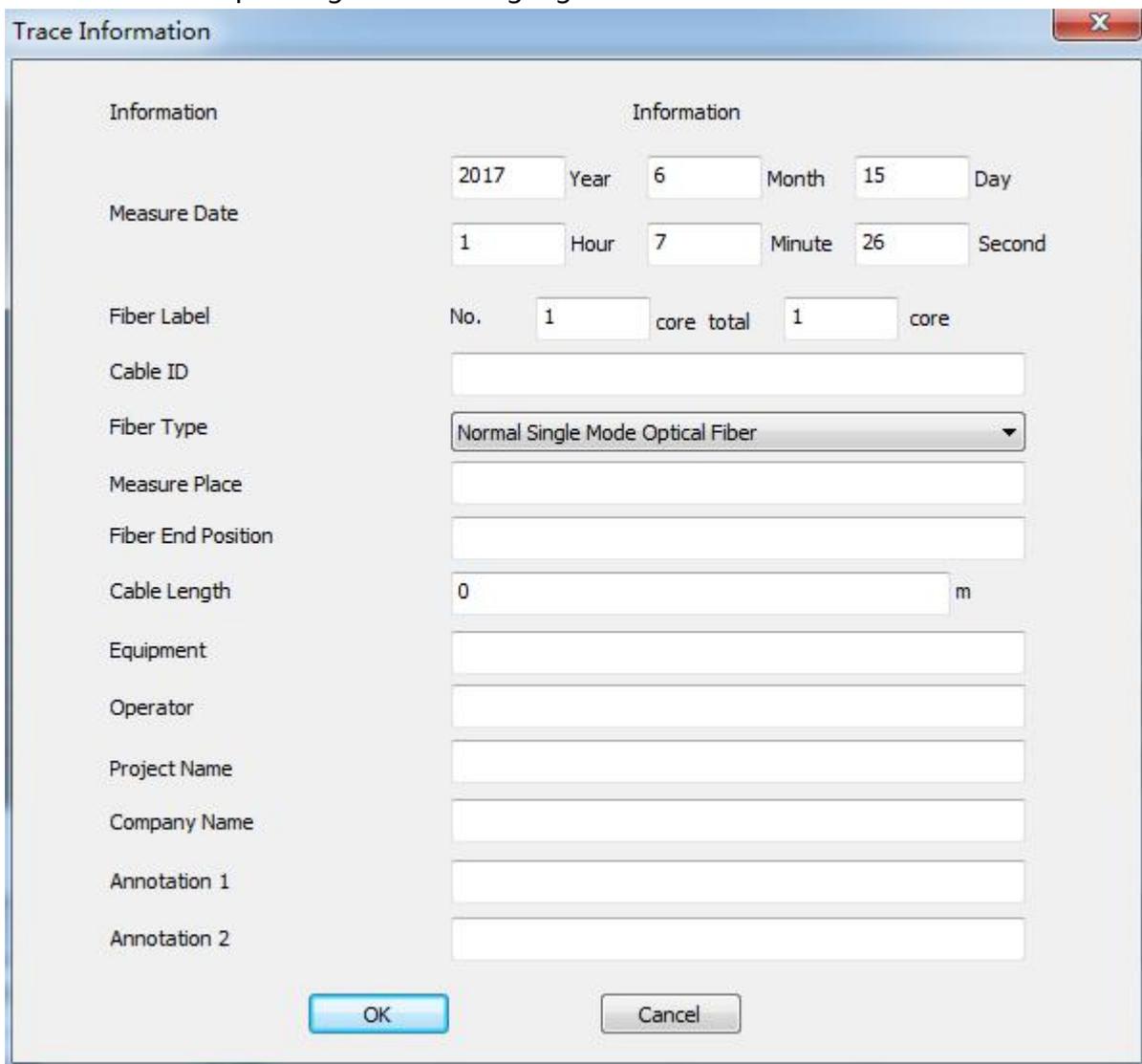
To click print/print preview, then the wave file can be chosen print/preview directly, the page is single wave page with this mode. The mode of “bulk print” can only support the print format of single wave page within same folder, the print format consist with all chosen wave files.

6、 Edit menu

The function in “edit menu”: edit wave information, add/modify/cancel event, batch modified wave information, it can modify the wave information by “edit wave information, it can modify the event list information by “add/modify/cancel events”,it can modify the wave information by batch modified wave information.



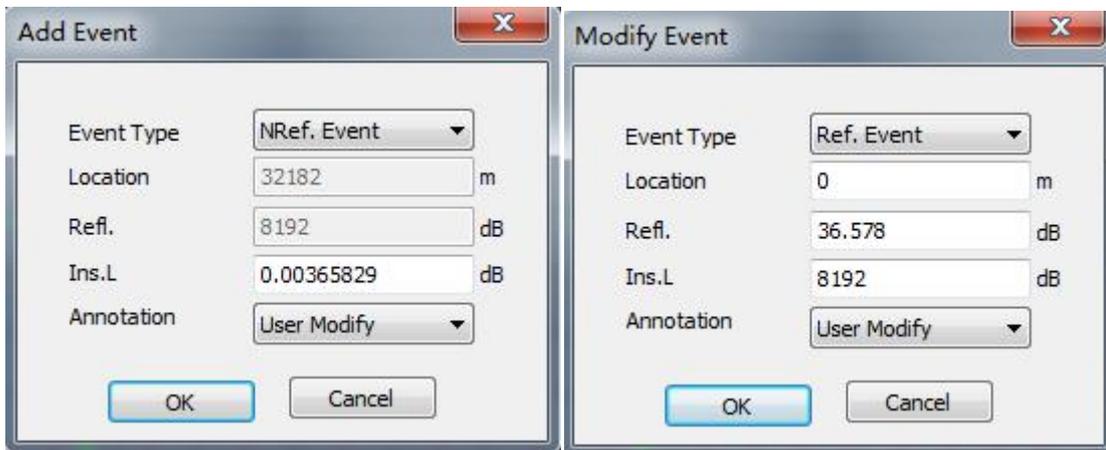
The “edit trace information” can modify the trace information of current wave file, the context of trace information is corresponding to its OTRD gauge.

A screenshot of a dialog box titled "Trace Information". The dialog contains the following fields and controls:

- Measure Date: 2017 Year, 6 Month, 15 Day
- Measure Date: 1 Hour, 7 Minute, 26 Second
- Fiber Label: No. 1 core total, 1 core
- Cable ID: [Empty text box]
- Fiber Type: Normal Single Mode Optical Fiber (dropdown menu)
- Measure Place: [Empty text box]
- Fiber End Position: [Empty text box]
- Cable Length: 0 m
- Equipment: [Empty text box]
- Operator: [Empty text box]
- Project Name: [Empty text box]
- Company Name: [Empty text box]
- Annotation 1: [Empty text box]
- Annotation 2: [Empty text box]

At the bottom, there are "OK" and "Cancel" buttons.

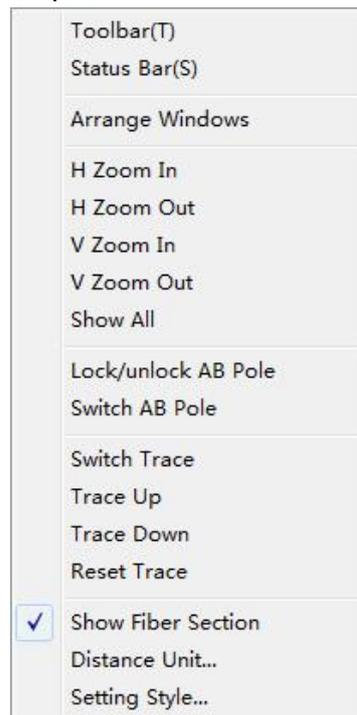
“The event of add/modify/cancel” can modify the event data of current cursor.



“The batch modify” can only support the operation of batch modify for trace information of wave file in the same folder.

7、 View menu

The function of “view”: The toolbar/the display of status bar, window reset in each function, the operation of each wave tool in wave zone, optional fiber section displayed in event list, setting style.



8. Report menu

There are two modes of report function “Single page multi-traces Report” and “Multi-traces display Report”.



8.1. Single page multi-traces Report

In the process of multi-traces Report with single page, the first thing is to choose printed file, the number of chosen files \leq the number of required printing wave. When printing the single page with multi-trace Report, the wave information default zone is the wave information default zone is the wave information of the first chosen files. We only support wave files of executing the multi-waves print with single page in the same folder. The printing mode of single page multi-traces quota can support printing format of wave files in the same folder which corresponding to the printing format of chosen wave file. The single page multi-traces of chosen wave file. The single page multi-traces Report printing also provide four types of setting styles of printing page: 2 waves/page, 4 waves/page, 6 waves/page, 8 waves/page.

8.2. Multi-traces display Report

The print mode only allows print of trace files less than 3 under the same folder. Select files according to the order 1, 2 and 3. When printing, trace files will display the corresponding figure and wave length information. In addition, under the print mode, the first selected trace file (i.e. the uppermost one) is defined as the master file. The trace information on each page of the printed file should conform to that of the master file. “Multi-traces display Report” only allows print mode of trace file under the same folder.

9、 OTDR Products Maintenance and Service

9.1、 Operation Note of OTDR Product

- Always clean the connector of the optical interface before using.
- Avoid the equipment being contaminated by dust.
- Please clean the shell and the front panel with slightly wet cotton cloth.
- Store the equipment in clean and dry places under room temperature and keep it away from sunlight.
- When using, control the humidity at a lower level and avoid significant temperature changes.
- Avoid unnecessary knocking and vibration.
- If any fluid sprays onto the surface or penetrates into the equipment, please turn off the power until the equipment dries completely.

Warning:

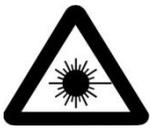


If the operation and maintenance process of control, adjustment and implementation doesn't comply with the following nominated operation regulations, it may lead to dangerous radiation.

9.2、 Cleaning the Connector of Optical Interface

Cleaning the connector of the optical interface periodically is helpful for keeping the best measurement performance of the instrument. The optical fiber interface of the instrument must keep cleaning. The optical interface needs to be wiped periodically with dedicated alcohol. After using, cover the dust cap, meanwhile; keep the cleanness of the dust cap. In addition, clean the connector of flange periodically. There is no need to dismantle the equipment when cleaning.

Please comply with the following safety rules when cleaning:



a) When cleaning the equipment, make sure turning off the instrument. If inspect the surface of the connector when the equipment is working, the eyes will be injured forever.

b) When cleaning any optical interface, laser source is prohibited.

c) Avoid lightning stroke. Before cleaning, disconnect the power of the instrument. Use dry or slightly wet soft cloth to clean the external of the equipment case. Do not clean the inside of the equipment case.



d) Do not install components onto the optical equipment or randomly adjust the optical equipment.

e) Please ask qualified and professional maintenance personnel that approved by our company to repair the equipment.

Cleaning operation steps:

- 1) Take down the connector of the optical interface from the instrument. The base and pin of the connector will be revealed.
- 2) Wet a 2.5 mm cleaning rod with a drop of isopropyl alcohol (if use too much alcohol, vestige may be left).
- 3) Gently plug the cleaning rod into the optical interface adapter until it stretches out from the other end (rotating clockwise is good for cleaning).
- 4) Gently rotate the cleaning rod for a circle, and keep rotating it when drawing it out.
- 5) Use a dry cleaning rod to do the action in step 3 and 4. Note: do not touch the soft end of the cleaning rod.

6) Clean the pin in the port of connector according to the following steps:

- Drip a drop of isopropyl alcohol onto the nonlinting cloth, Gently wipe the connector and the pin.

Key prompt:



If use too much isopropyl alcohol or let it evaporate randomly (about 10 min), residual may be left. Avoid the bottleneck touching the cloth to make the surface dry rapidly.

- Gently wipe the same surface with a dry nonlinting cloth to ensure the connector and the pin completely drying.

• User can use a portable optical fiber microscope or detector to inspect the surface of the optical connector.

7) Install the connector of optical interface back to the instrument (push and rotate it clockwise).

8) Discard the cleaning rod and cloth after using once.

9.3. Maintenance and Changing of Battery

OTDR series optical time-domain reflectometer adopts inlaid rechargeable lithium battery.

Maintaining battery should pay attention to the follows:



- You' d better store the instrument (including battery) under room temperature (15°C to 30°C), and place it at dry place to keep its best performance.

• If the instrument is left unused for a long term (leave unused for more than 1 month), you' d better charge the battery once a month.

• Do not charge the battery too long (exceeding 8 hours), otherwise the battery may be damaged;

- Battery changing operation steps are as follows:

a) Take down the cover of battery storage;

b) Firstly, move the rechargeable battery away, then, draw out the battery connector from the plug hole of the rechargeable battery.

9.4. Calibration of OTDR Products

ORIENTEK Optical Technology Ltd.(www.orientekot.com) calibrates the product according to ISO/IEC 17025 standard. The standard regulates that the calibration file can exclude the recommended calibration interval, unless otherwise achieved agreement with customer.

The effectiveness of regulations depends on the operation conditions. For example, the effectiveness of calibration can be prolonged or shortened according to the using intensity, environmental conditions and equipment maintenance. Please confirm the proper equipment calibration interval according to the demands of accuracy.

Under the condition of normal using, ORIENTEK Optical Technology Ltd.(www.orientekot.com) recommends recalibrating the equipment every three years. Equipment calibration work needs to be conducted in manufacturer' s factory.

9.5. Service and Guarantee

9.5.1. General Information

We promises to maintain the defects of OTDR caused by material or technology within one year since the original delivery date. We meanwhile promises that the equipment complies with the applicable regulations under normal using status.

Within the guarantee period, We has right to maintain or change any products with problems, this

regulation also suitable for checking or adjusting the products waiting for maintenance, or re-checking or re-adjusting the products wrongly calibrated before. Beyond the guarantee period, if the equipment needs to repair in the manufacturer's place, We will charge a certain maintenance fee.

This guarantee declaration will replace the former clearly stated, implicated, and legal guarantee declarations, including, but not limited to implicated guarantee declaration about goods marketability and adaptability regarding special usage. Under any conditions, We won't undertake the responsibilities for damages caused by special troubles or accidents.

Key prompt:



Any the following situation happens, guarantee is invalid:

- Equipment damage caused from maintenance or treatment by unauthorized personnel or non our technicians.
- Anti dismounting labels are torn up.
 - Serial number of the equipment is modified, erased or worn.
 - Equipment damage caused by improper using, negligence or accident.

9.5.2. Responsibilities

We won't be responsible for using damage, or performance failure of the other equipment connected to the product, or operation failure of any related system of the product.

We won't be responsible for the damage caused by improper using, or damage caused by modifying the equipment, attachment or software without authorization.

9.5.3. Disclaimer

We has right to change the design or structure of any product, and has no duty to change the sold product according to requirement of any user. Various attachments, including but not limited to fuse, indicator, battery and general joint used by our products aren't included in the guarantee scope.

If any of the following conditions occurs, the guarantee will become invalid: improper using or installation, normal wearing or fracture, accident, violations, negligence, firing, water logging, lightening or other nature accident, reasons beyond the product or other reasons beyond our control.



Key prompt:

We will charge fees for changing damaged optical connectors caused by improper use or harmful cleaning.

9.5.4. Maintenance

If your product needs maintenance, please attach the failure phenomenon report and repairing address along with the product when mailing back to the manufacturer. Please use original packaging material to pack the equipment when mailing.

If possible, please back up your data before sending the equipment.

After repairing, we will send out the equipment attached with a maintenance report. If the equipment is beyond the guarantee scope, user should pay the expense stated on the maintenance report. If the equipment is within the guarantee scope, we will pay the back freight.

To accelerate problem treatment process, please clearly list the product name, serial number (refer to ex-factory label on the back cover of battery storage of OTDR product), and statement of problems.

9.6 Transportation

When transporting the equipment, the temperature must be maintained in a regulated scope. Equipment may be damaged during the transportation process because of improper operation.

We suggest complying with the following procedures, so as to reduce the damaging possibility:

- When transporting, pack the equipment with original packaging material.
- Avoid over high humidity or over large temperature changing.
- Avoid direct sunlight.
- Avoid knocking and vibration.

10、 Common Failure Diagnosis of OTDR product

- Common problems

Problem 1: Blank screen or cannot start up.

Possible reason: Electricity is used up.

Solving method: Charge the battery. Use AD-DC adapter to connect the equipment with external power supply.

Problem 2: Button can't work properly.

Possible reason: The button is damaged.

Solving method: change the button board

Problem 3: data saving aren't allowed.

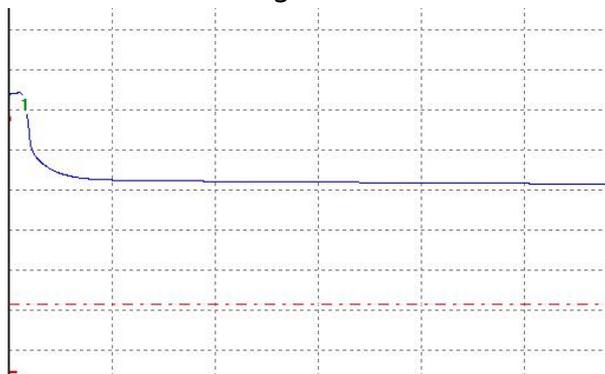
Possible reason: SD card is used up.

Solving method: Export the curve to empty the memory.

- Optical fiber connection problem

Improper optical fiber connection may lead to trace measurement failure, instructions are as follows:

Problem 4: if the measured trace is as shown in Fig:



Possible reasons: ① Using improper optical fiber jumper joint ② The connector isn't clean ③ The connector is ageing	Solving method: ① change the optical fiber jumper ② Clean the connector ③ Change the connector
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Problem 5: if the measured trace is as shown in Fig:



<p>Possible reasons:</p> <ul style="list-style-type: none"> ① Improper connection ② Inclined connector para-position ③ Misaligned dowel pin 	<p>Solving method:</p> <ul style="list-style-type: none"> ① Reconnect ② Change the connector
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● Testing setting problem

Problem 6: The trace curve is too short, and the measurement time is too long.

Possible reason: The set testing distance is too long.

Solving method: Set proper length scope according to the actual length of optical fiber or the length that found by the automatic measurement model.

Problem 7: Only partial trace is displayed, which causes test failed.

Possible reason: The set testing distance is too short.

Solving method: The testing distance should be set larger than or equals to the actual length of optical fiber

Problem 8: partial events are measured

Possible reason: Too big pulse width

Solving method: 1. Choose a smaller range of pulse width.
2. Increase testing time.

Problem 9: The trace is too noisy.

Possible reason: The pulse width is too small, and the scanning time isn't enough.

Solving method: 1. Increase the testing time.
2. Increase the pulse width properly.