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FHO5000 Optical Time Domain Reflectometer (OTDR)

Manual

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Manual

Foreword

Thank you for purchasing FHO5000 OTDR (Optical Time Domain Reflectometer).This user's manual contains useful information about the instrument's functions and operating procedures and the handling precautions of FHO5000 OTDR.To ensure correct use, please read this manual thoroughly before beginning operation. After reading the manual, keep it in a convenient location for quick reference whenever a question arises during operation.

Note

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest GRANDWAY dealer.
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- Respective trademark names or registered trademark names.

Version

E1200

Standard Accessary

OTDR standard accessary showed in next table.

Num.	Description	Quantity
1	Power Adapter(220V 50Hz)	1
2	Power Patchcord	1
3	Data Cable	1
4	CD	1
5	Carrying Case	1
6	Securing Strip	1
7	Manual	1

Module

OTDR optional accessary showed in next table.

Num.	Item	
1	OTDR1 module	Standard
2	VFL(visual fault locator) module	Standard
3	OTDR2 module	Optional
4	OPM(optical power meter) module	Optional
5	OLS(optical laser source) module	Optional
6	FIM(fiber inspector) Module	Optional
7	Waterproofing work	Optional
8	Touch Screen	Optional

* All changes with standard accessary and optional accessary prices are subject to change without notice.

Safety Precautions

To use the instrument safely and effectively, be sure to observe the precautions given in the user's manual. Not complying might result in injury or death.

Before test with OTDR module please ensure there is no active signal in optical network under test, any signal which power is higher than 0dBm will permanently damage this meter and this kind of damage are not within the scope of free warranty!

Warning

Use the Correct Power Supply
Before connecting the power cord, ensure that the source voltage matches the   rated supply voltage of the AC adapter and that it is within the maximum rated   voltage of the provided power cord.

Use the Correct Power Cord
Use only the power cord that comes with the instrument. Do not use it for other devices.

Use the Correct AC Adapter
Use only the AC adapter specified for the instrument. Do not use it for other devices.

Use Only the Designated Battery pack
Use only the battery pack specified for the instrument. Do not use it for other   devices.

Do Not Look at the Laser Light
Do not look at the laser's direct ray, reflected ray from a mirror, or indirect ray without the proper protective eyewear. In addition, avoid being exposed to the laser light. It can cause blindness or damage to the eye.

Do Not Operate in an Explosive Atmosphere
Do not use the thermocouple in a location where any flammable or explosive gas/vapor is present. Operation in such an environment constitutes a safety hazard.

Do Not Remove Covers
The covers should be removed by qualified personnel only.
Opening the cover is dangerous, because some areas inside the instrument have high voltages.

Carrying and Moving the Instrument
Remove all power cords and connection cables from the main unit before moving the instrument. When carrying the instrument, hold it firmly by the handle.   Also, if storage media is inserted into the instrument, always remove the storage media before carrying or moving the instrument. Never leave the media inserted when carrying or moving. The storage media can become damaged.

Symbol

Icons on the main body or in manual

Warning: handle with care. Refer to the user's manual or service manual. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions
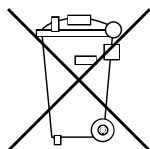
Direct current

Stand-by (power)

Recycle

Hazard, radiation of laser apparatus
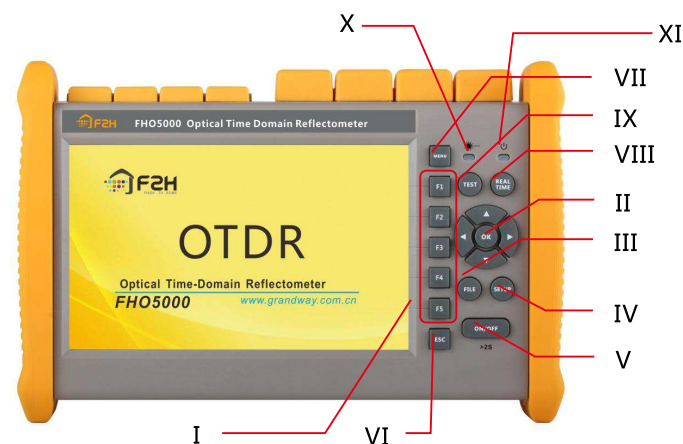
Comply WEEE(Waste Electrical and Electronic Equipment) Directive (2002/96/EC)

Content

0.0 Names and Functions of Parts

0.1 Front Panel

Num.	Item	Function
I	Tag select button(F1-F5)	Enter relevant menu
II	Direction key	Move cursor and confirm
III	FILE	Open Database
IV	SETUP	Proceed quick set
V	ON/OFF	Turn on/off OTDR
VI	ESC	Cancel current menu
VII	MENU	Back to menu
VIII	REAL TIME	Realtime test mode
IX	TEST	Averaging test mode
X	Test State Indicator	Indicate test state (green-averaging mode, red-realtime mode)
XI	Power Indicator	Indicate working state and charging state (**Green**-working state or fully charged, **Red**-charging)

0.2 Top Panel

0.3 Back Panel
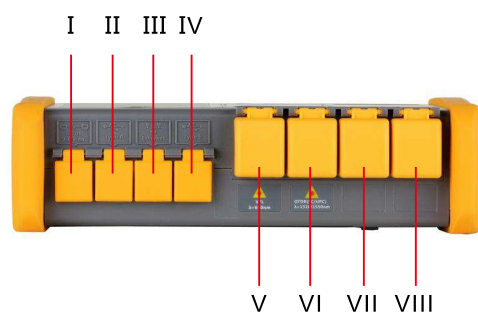
Num.	Item	Description
I	AC-DC port	Connect to AC adapter
II	Main USB	Connect external device like: U disk ,keyboard and FIM Probe
III	Internet Access	Connect to internet
IV	Sub USB(mini USB)	Remote control through PC
V	VFL(visual fault locator) port	VFL module port
VI	OTDR1 port	1310/1550nm Test/Laser Source port
VII	OTDR2 port	850/1310nm or 1625nm Test/Laser Source port
VIII	OPM(Power Meter) port	
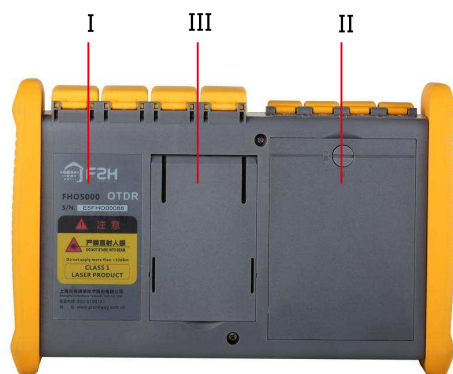
Num.	Item
I	Warning label
II	Battery compartments
III	Supporting plate

0.4 Side Panel
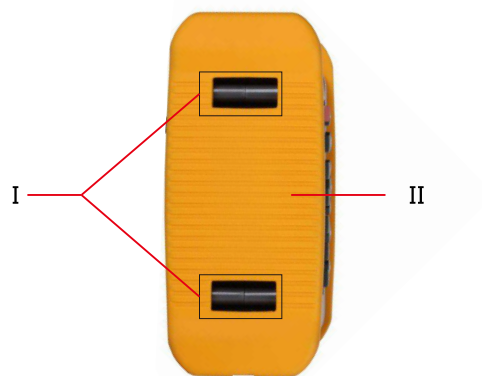
Num.	Description
I	Handle belt buckle
II	Fenders

0.5 Main Menu Interface
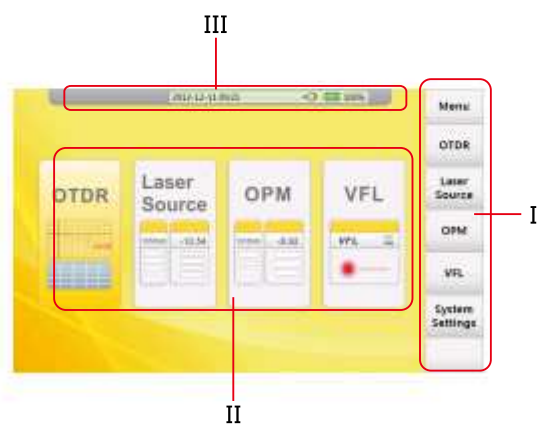
Num.	Function	Description
I	Side menu	Enter relevant interface
II	Function Modules Area	Enter relevant module
III	Basic State Information Area	Display information of date ,time and power

0.6 OTDR Module Interface
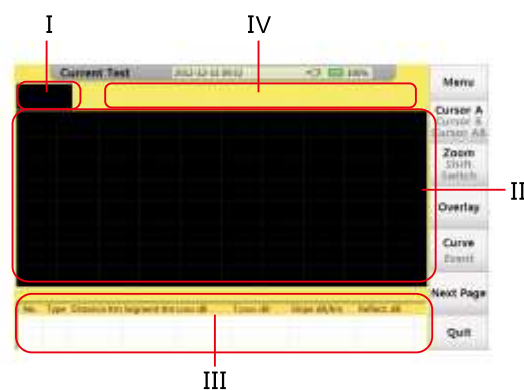
Num	Function	Description
I	Thumbnail of current curve	For user's reference to the integrated curve.
II	Curve display and operating area	Display events and curves.
III	Event list area	Display event information including: "Type","distance(Km)","Loss(dB)","T.Loss(dB)","Slope (dB/km)" and "Reflection(dB)".
IV	Test condition information area	Display condition information of test including"PW"(Pulse width), "WL"(wavelength),resolution of X axis and Y axis(dB/div),distance,averaging and total loss from cursor A to cursor B.

0.7 VFL Module Interface
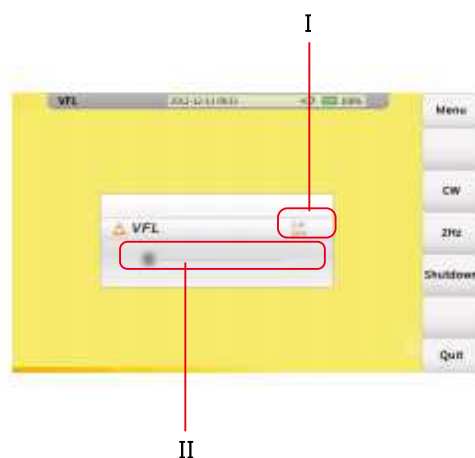
Num	Function
I	VFL mode indicator
II	Launching state indicator

1.0 Preparation

1.1 Attaching the Belt
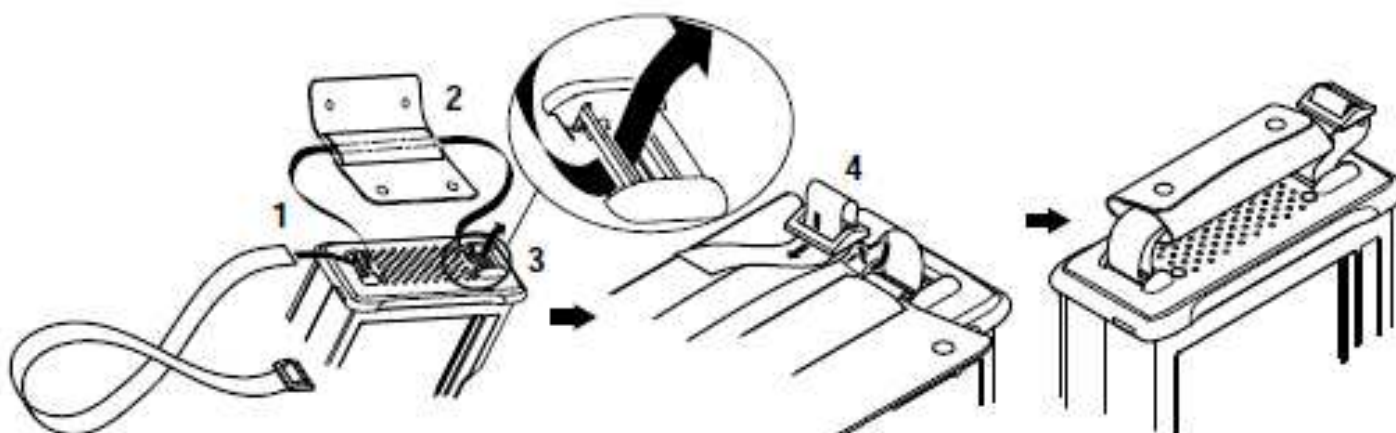
Procedure:

1. Introduce belt through the buckle.

2. Put on the sheath .

3. Introduce belt through another buckle.

4. Fix the belt.

1.2 Connecting the Power Supply

Using AC adapter

AC adapter

Patchcord

Connect to adapter after shut down
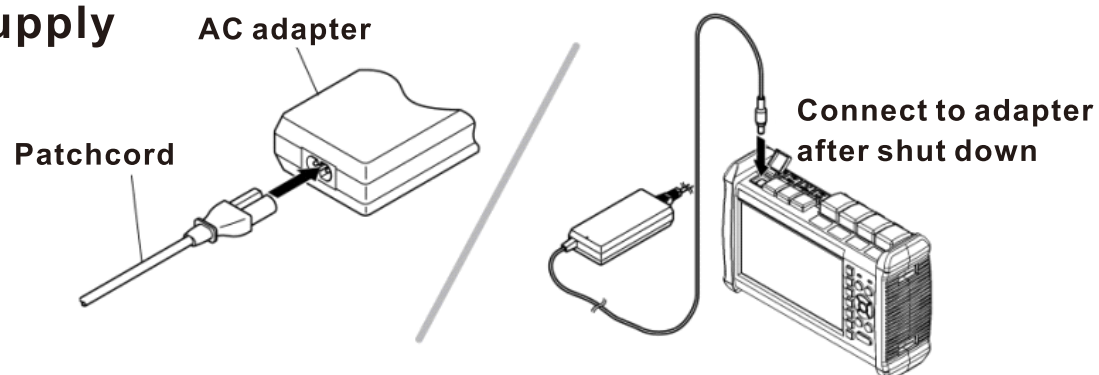
Once connect to AC adapter , power indicator turns red(if it is not fully charged), adapter is charging the battery , after fully charged power indicator turns green.

Installing Battery

1. Rotate buckle anticlockwise to open.
2. Install battery.
3. Close the cover, rotate buckle clockwise to close.

Caution

- Proper charging temperature is: -10~50℃ ,high charging temperature may shorten battery life.
- Charging time is about 5 hours with power on, about 3 hours with power off .
- Don't charge battery more than 8 hours.

1.3 Turning on

Press power button(>2s) to turn on OTDR, power state indicator turns green .when power is low some warning information will display on the screen.

Power state indicator

Green light: Working state or fully charged

Red light: Charging state

Launching state indicator

Green light: Proceed realtime test

Red light: Proceed averaging test
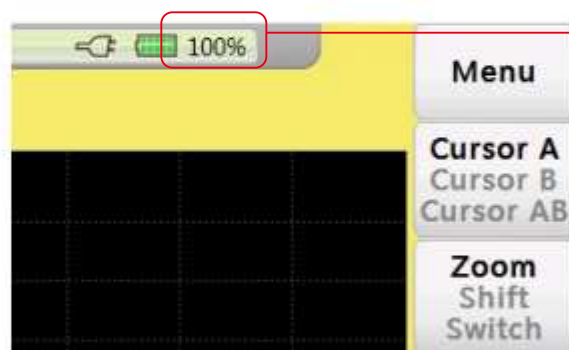
Power Indicator

	Full
	80% Power
	60% Power
	40% Power
	20% Power
	Less than 20%

Caution

- In case of low power, special icon will appear, and after that for a while FHO5000 will turn off automatically.
- If it has not been used for an extended period of time,FHO5000 will turn of immediately after turned on to protect the internal battery ,please connect the AC adapter adapter.

1.4 Connecting the Fiber

Before connect fiber to FHO5000,clean fiber end first ,the dust which on the end of connector may damage the optical port or reduce test quality.

Procedure:

1. Put connector against the cleaner.

2. Rotate the handle of cleaner.

3. Rub each other carefully to clean the contaminant.

4. Repeat procedure 1 and 3.

5. Open the protecting cover of optical port.

6. Insect connector into optical port carefully.

Cleaner
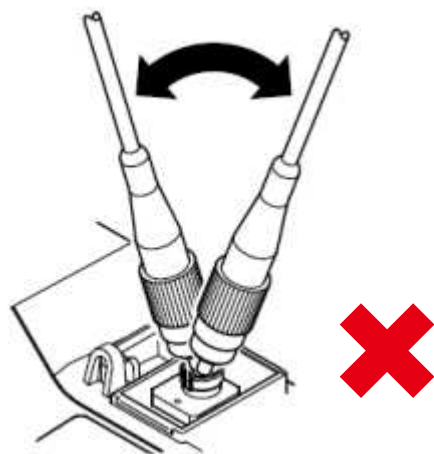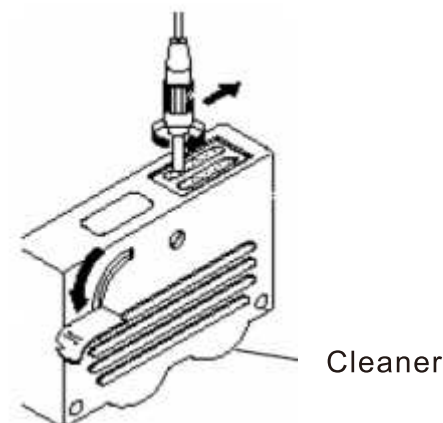
Caution

Insect connector carefully into optical port, unproper operation may cause the damage of optical port.

Warning

Before connection with OTDR module, make sure that there is no optical signal exist inside the fiber.

2.0 Introduction of OTDR

2.1 Purpose of Measurement

OTDR shows the back-scatter light power of the optical signal relative to the distance. With this information, the OTDR could measure a series of important information of an optical fiber such as the quality of the line, distance of the line and etc.

2.2 Content of Measurement

- Event position—a broken point or the end of the tested fiber.
- Optical attenuation coefficient of a optical fiber.
- Single event loss, such as the loss of a connection or a macro bending. Or the loss of a end-to-end line on the tested optical fiber.

2.3 Analyze of Curve

OTDR can auto analyze a tested trace, the position process shows below:

- Get the reflection events generated by connectors or mechanical splicer.
- Non-reflection events(usually it is splicing points or macro bending).
- End: the first point which the loss of it is over the threshold would be scanned as the end of a trace.
- Events list: event type, loss, reflection and distance.

Normal Curve
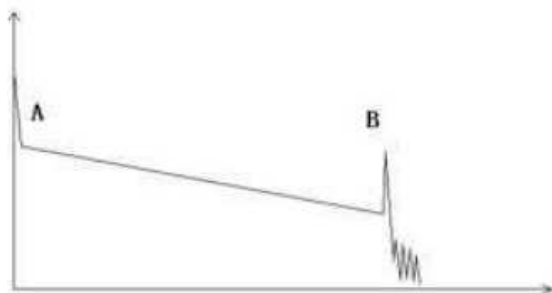
A normal trace shows as above, the A mark is a start-peak and the B mark is a end-reflection-peak. The tested trace is oblique, the total loss will become bigger with the increasing of the fiber length. The total loss(dB) divides total length is the average loss(dB/km) of a fiber.

Curve with Jumper Connected

If there is additional reflection peak in a tested trace, this may be caused by a connection point or some other reasons. Anyway, appearance of the reflection peak shows that the two connecting surfaces of the connection are smooth. The smoother the connection surfaces are, the higher the reflection peak is.

For an instance, if a broken optical line is under test, the OTDR trace will show a broken point. After a maintenance of this line, use the OTDR test it again, we may see a reflection peak replacing the broken point on the OTDR trace, this shows the maintenance is done.

Curve with Broken Point

If the tested trace is just like the figure shows above, this might be caused by several reasons like: a bad connection between the connector and the lunching port, the optical pulse cannot be launched into the optical fiber or a short distance broken point of the tested fiber from the initial connection and the preset testing distance and pulse width is larger.

To fix this problem, we should:

1. Check the connection of the connector and the launching point

2. Reset the test parameters, decrease the preset distance and the pulse width.

If the problem still exists, we could estimate:

1. The connector of the test fiber is broken or polluted.

2. The launching port on the OTDR is broken or polluted.

3. The distance of the broken point of the from the initial connection is too close.

Curve with Non-reflective Event
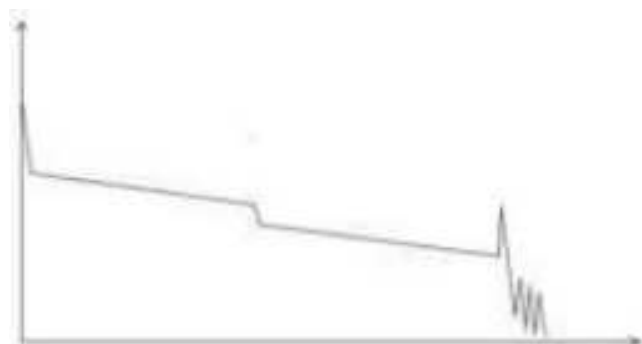
There is a common phenomenon that an obvious step is on the middle of a tested trace, it often caused by a fiber bending, fiber knot, being pressed by something heavy or a fuse splicing point. The step means a bigger loss of a fiber, it is also called event point. If the direction of it is downward, it could be called non-reflection event. If the direction is upward, we can call it reflection event.

Sometimes, the loss value could be a negative value, it does not means the loss does not exist. It is common phenomenon called pseudo gain, it is by a connection of two fibers with different back scatter coefficient, the scatter coefficient of the back fiber is large than the front one's. In addition, the different refract ratio also can cause the phenomenon. To avoid it, we could test a fiber bi-directionally.

Abnormal Condition

The situation that there is no reflection peak at the end of a trace shows above should be paid attention on. If the distance of the tested fiber is available and the distance shown on OTDR is not equal to the original distance, this shows that the fiber might be broken down or twisted and the bending radius of it is over limited. The distance shown on OTDR is the position of the fault point.

This phenomenon is often used in maintenance. If a fiber is uncertain, we can bend a fiber and make sure the bending radius is over limited, then use real time testing function of the OTDR to confirm the fiber.

Distance is Too long

This situation often happened in a long distance testing, caused by under-range dynamic range of the OTDR that the energy of it can not support a long distance transmission or caused by a under-range preset testing range of distance or pulse width corresponding to the actual fiber length. To avoid this situation, adjust the testing distance and the pulse bigger and extend the sampling time.

2.4 Fundamental of OTDR

OTDR——Optical Time Domain Reflector is a high precision optical testing meter that use the theory of Rayleigh scattering and Fresnel reflection. It is widely used in the maintenance, construction and monitoring of an optical line. All the important parameters like fiber length, optical loss, connection loss, broken or twisted point and etc. of a fiber can be shown on the OTDR. When the a light transmits along a fiber, it would be scattered to various directions caused by the difference of come properties of the transmission medium, this phenomenon called Rayleigh scattering. During the scattering process, some of the light will be scattered along the absolutely converse direction, this phenomenon is called Rayleigh back-scattering. It provides some details about the fiber length. The parameters about fiber length can be got by calculation with the parameter of time(This is the derivation of TD in OTDR——Time Domain optical Time Domain Reflectormeter).

These back-scattering signals shows the loss level of a fiber and through these information, OTDR can generates a backward oblique trace which reflects several important attributes of a optical fiber. When the light, transmitting downward along the fiber, meet a different density medium, a part of the light will be reflected, this phenomenon is called Fresnel reflection. There are many reasons can cause the changing of the medium density like a little slot at the splicing point, a broken of fiber or etc. This phenomenon is usually used to locate the discontinuous point. Compare to the Rayleigh scattering, the consuming amount of the light in Fresnel reflection is much more then it is in Rayleigh scattering. The power of Fresnel reflection is tens of thousands times to the back-scattering's. The reflection level depends on the changing grade of refraction ratio.

Formula of the distance: distance = (c/n)*(t/2).

Here: c is the light speed traveled in vacuum(2.998*108m/s).

T is the delay between launching pulse and receiving pulse.

N is the refraction ratio of the testing fiber(specified by manufacturer).

When display the whole trace, each point of the trace represents the average value of several sampling points. By zoom in and zoom out function, the value of each sampling point can be got.
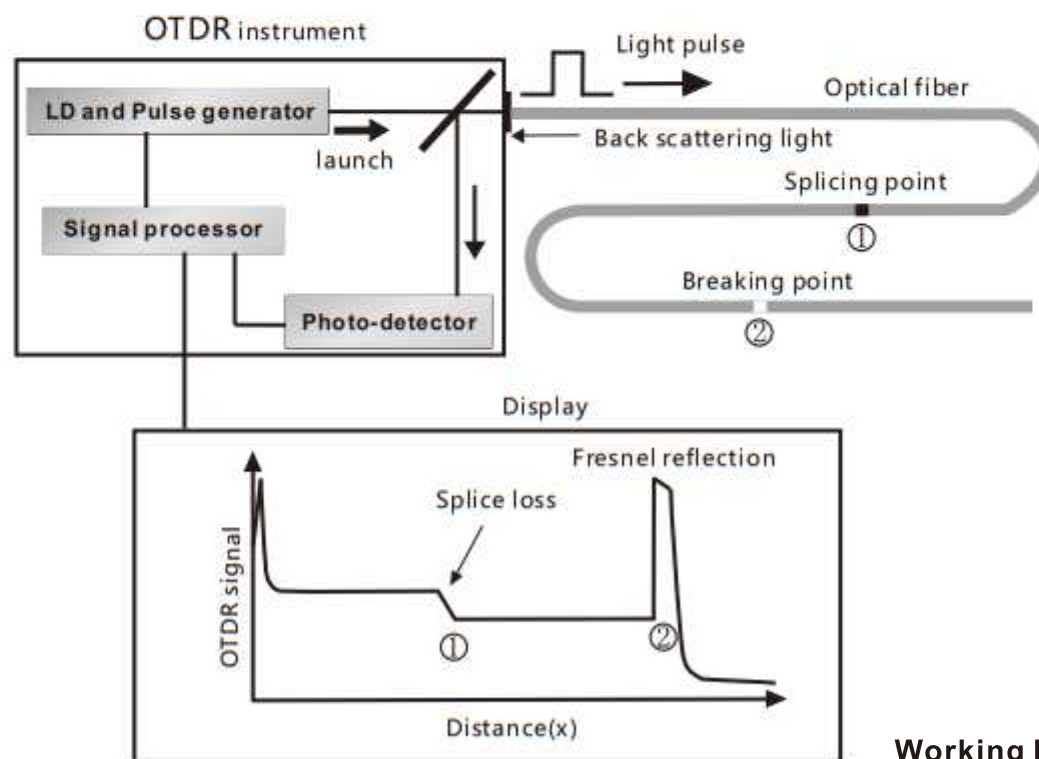
Working Principle of OTDR

2.5 Event Type

Start event or non
reflection event

Reflection event

End event
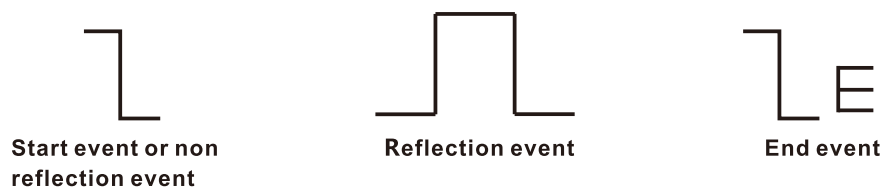
The events on trace are all the points that the value of power loss fluctuates abnormally. It usually contains various types of connection and bending, crack, broken and etc. The event points marked on trace with special marks are the abnormal points in a fiber that cause the excursion of a normal trace.

The events can be divided into Reflection-event and Non-reflection-event

Start event

The Start-Event on a OTDR trace is the initial point. Under the default setup, Start-Event is located on the first event(usually it is a connection between the OTDR launching port and the connector of a fiber) of a fiber. It is a Reflection-event.

End event

The End-Event on a OTDR trace is the end point of a fiber. Under the default setup, End-Event is located on the last event(usually it is an end face or a broken down point of a fiber). Usually, it is a Reflection-event.

Reflection-event

The phenomenon on a trace that some power of the optical pulse is reflected called a reflection event. Reflection-event is displayed as a peak signal on a trace.

Non-reflection-event

The phenomenon on a trace that there exists some abnormal loss in a optical line, but no reflection occurred is called a Non-reflection-event. It is displayed as a drop with no peak on a trace.

Event detection

OTDR launches a bunch of optical pulse into a under-test fiber, receives the returned optical signal and starts calculating the distance from a event. The more the distance from the event is, the longer the returning time is cost. According to the receiving time, distance can be calculated. By detecting the trace generated by the returned optical signal, the attributes of the fiber itself, the connector of the fiber, adaptor in the fiber and splicing point in the fiber can be confirmed.

3.0 Setting Measurement Conditions

Press 【SETUP】button on the panel to enter test setting interface.

The meaning of items indicated in the following table:

Test Wave	Test wavelength of OTDR.
Test Mode	Auto Mode: FHO5000 will set best parameters for current test Manual Mode: set parameters manually.
Test Time	Under averaging test mode(TEST), longer test time has better SNR (Signal Noise Ratio) but takes more time .
Test Range	Test distance of OTDR .adjust only in manual mode, in auto mode this item set as "Auto".
Pulse Width	Wider pulse has stronger backward signal, OTDR has longer detecting distance but wide pulse width will cause the saturation of backward signal, make blind area bigger. so the selection of pulse width has close relationship with the length of fiber. Long fiber has wide pulse width.. pulse width could only modified in "Manual"mode.
Resolution	Sampling resolution of test. High resolution has more sample point and high precision, but take more memory space.
Unit	Unit of test result, including km/kfeet/miles.

3.1 Setting to Auto Mode

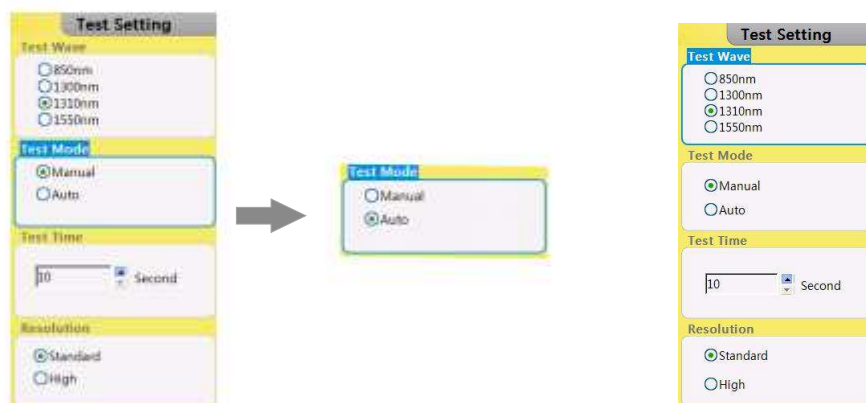In Auto mode,you could just proceed test by setting proper wavelength.

Procedure:

1.Press【SETUP】button to enter "Test Setting" interface.

SETUP

2. Set "Auto" mode.   3.Set test wave.

Caution

Auto test mode is not suitable to proceed Blind area test,user should enter "Manual" mode and choose "Blind area test" to proceed blind area test.
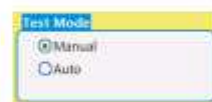
3.2 Setting to Manual Mode

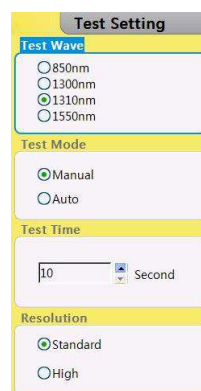In manual mode,user could set proper range and pulse width manually.

Procedure:

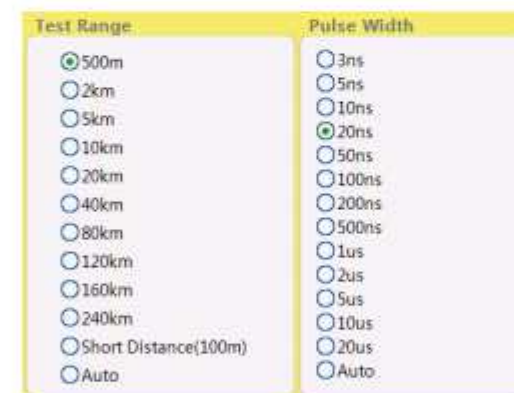1.Press 【SETUP】 button to enter "Test Setting" interface.

2. Set "Manual" mode.

3.Set test wave.

4.Set range and pulse width.

Caution

● When "Pulse width" set to "Auto", test will choose proper pulse width automatically.

● When "Test Range" set to "Auto", test will choose proper range automatically.

● Once you set the "Test range", "Pulse width"item will adjust automatically you could also adjust manually.

Proper relationship between Range(MR) and pulse width(PW)(For user's reference only):

| PW \ MR	100m	500m	2km	5km	10km	20km	40km	80km	120km	160km	240km
3ns	√	√	△	△	△	△	△	△	△	△	△
5ns	√	√	√	△	△	△	△	△	△	△	△
10ns	△	√	√	√	△	△	△	△	△	△	△
20ns	△	√	√	√	√	△	△	△	△	△	△
50ns	△	△	√	√	√	√	△	△	△	△	△
100ns	△	△	△	√	√	√	△	△	△	△	△
200ns	△	△	△	△	△	√	√	△	△	△	△
500ns	△	△	△	△	△	△	√	√	△	△	△
1us	△	△	△	△	△	△	√	√	√	△	△
2uns	△	△	△	△	△	△	△	√	√	√	△
5us	△	△	△	△	△	△	△	√	√	√	√
10us	△	△	△	△	△	△	△	△	√	√	√
20us	△	△	△	△	△	△	△	△	△	△	√

4.0 Making Measurements

FHO5000 has two test modes: averaging test mode and realtime test mode.

4.1 Averaging Test Mode

Averaging test mode can calculate the data of curve over a period of time and display as a averaging one ,test time could set "Test Time" in "Test Setting".

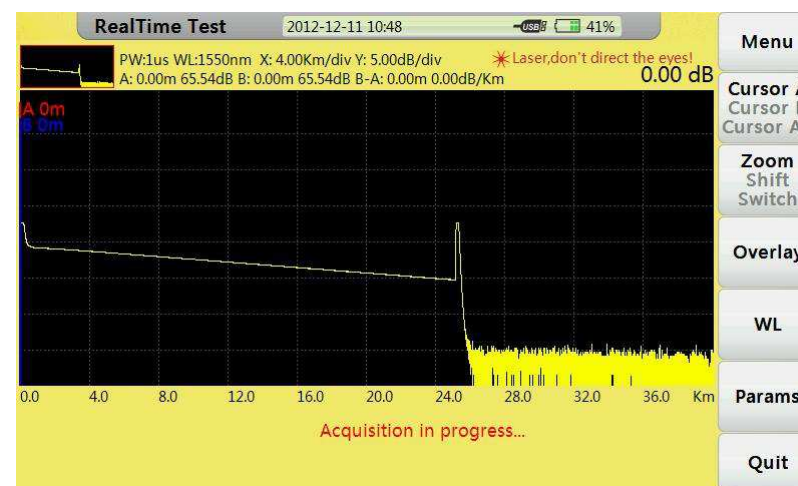Press 【TEST】 button on the control panel, test state indicator turns red, enter averaging test interface.
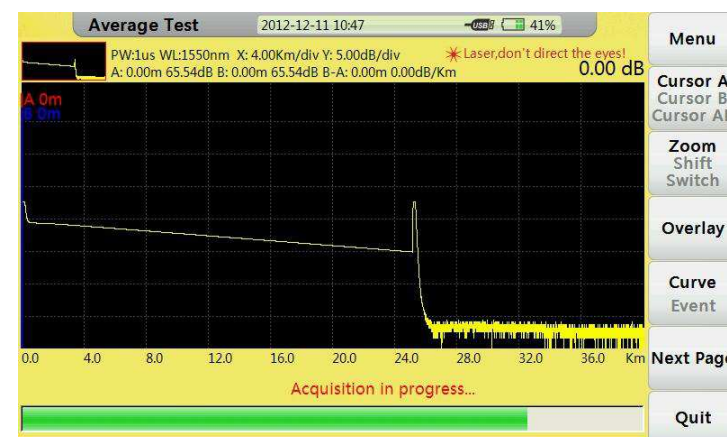
Averaging test interface

4.2 Realtime Test Mode

Realtime test mode could check network , adjust test range and pulse width in real-time.

Press 【REALTIME】 button on control panel, test state indicator turns green,enter realtime test interface.
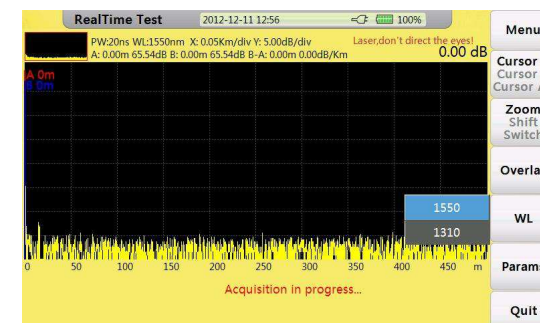

Realtime test interface

4.2.1   Setting Wavelength
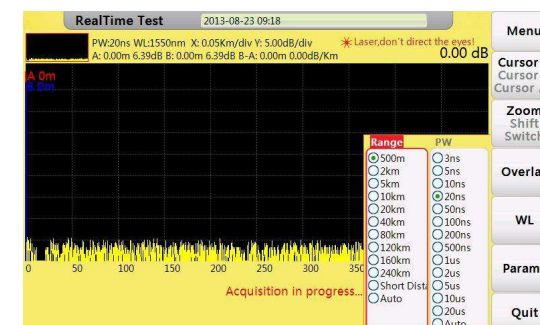
Procedure:

1. Select wavelength (WL) tag to set wavelength.

2. Confirm by 【OK】button.

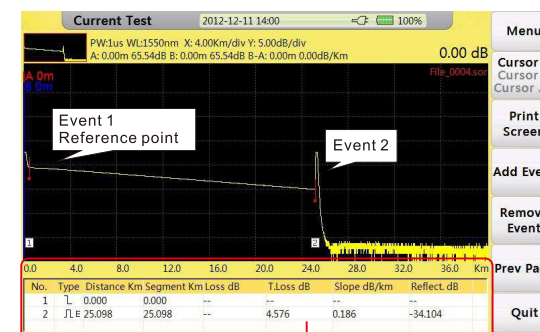### 4.2.2   Setting Test Range and Pulse Width

Procedure:

1. Select tag "Params" to set Test range(MR) and Pulse width(PW)button.

2. Confirm by 【OK】button.

4.3   Event List

After test, event list will appear immediately at the bottom of the window, user could get detail information about this test from the list.

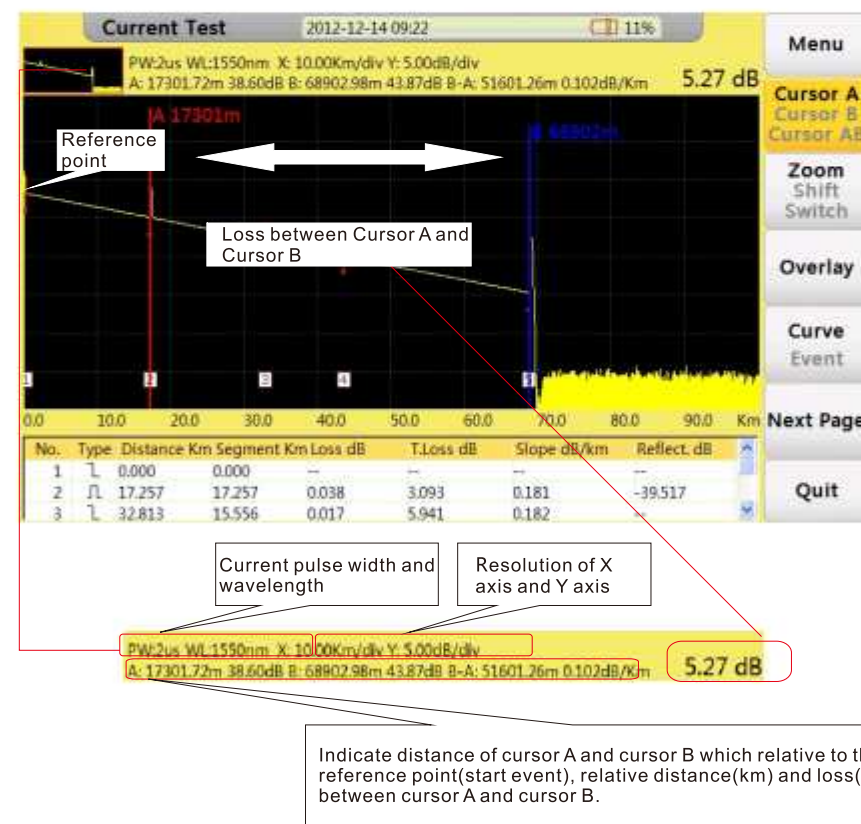**Event List**

Description of items showed in chart below:

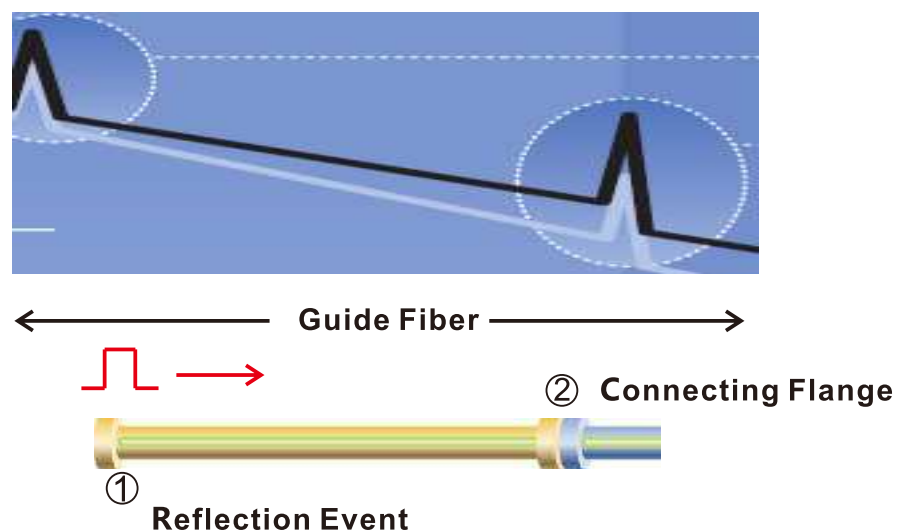| Num	Item	Description
I	Type	Type of event(Attenuation events, Reflection events and End event)
II	Distance	Distance from start point to event
III	Section	Distance from this event to last event.
IV	Loss	Loss of this event(dB)
V	T. Loss	Total loss from start event to this event(dB)
VI	Slope dB/km	Ratio of event loss value(dB) (from this event to last event)to distance (Km)(distance from this event to last event)
VII	Reflect.dB	Return loss of this event(dB)

4.4   Distance Measurement

Measure the distance from one point to another.

Procedure:

1. Press【F1】button to active cursor function.

2. Control 【◄】/【►】to move cursor A or B.

【◄】: move left   【►】: move right

3. Get information by following the guide below:

Reference point

Loss between Cursor A and Cursor B

Current pulse width and wavelength

Resolution of X axis and Y axis

Indicate distance of cursor A and cursor B which relative to the reference point(start event), relative distance(km) and loss(dB) between cursor A and cursor B.

4.5   OTDR Optimizing Tool

Guide Fiber

② **Connecting Flange**

①

Reflection Event

1.Guide fiber

Use an guide fiber to figure out the character of connector. By adding this fiber we could move the fist connector out of the blind area. In the same way we could use this way to figure out the character of last connector.

2.About guide fiber

Proper length of Guide fiber is 100~1000m, it depends on the blind area of OTDR. In theory, minimum length of guide fiber should be two times longer than attenuation blind area , but it should be longer in practice.

4.6　Setting Proper Parameters

At the fist time using OTDR, if user choose some testing parameter which is not suitable to the real condition may cause the bad result. User should take Testing range, pulse width and wavelength into consideration.

Setting proper testing range

Testing range means maximum display range. This parameter will indicate how long will OTDR display on its screen. this range must longer than testing fiber, Usually we choose range which is 20% longer than testing fiber. Take note that testing range should not has large difference with testing fiber, Otherwise it will affect the effective resolution and overlarge testing range will result in the generation of huge and useless data(see Figure 1).

Setting proper pulse width

Pulse width and blind area, dynamic range are directly related to the maximum length ,in below picture, use ten different pulse width to test one testing fiber.the smallest pulse width result in the smallest blind area and the most terrible noise. The longest pulse width result in the smoothest curve and almost 1km blind area(see Figure 2).

It is obviously at the top of testing fiber influence on Pulse width , in below chart,we cant detect the first connecting point locate in the 540m by large pulse width(see Figure 3).

Dynamic range decided by Pulse width, larger pulse width will spend more optical power, but it reach further(see Figure 4).
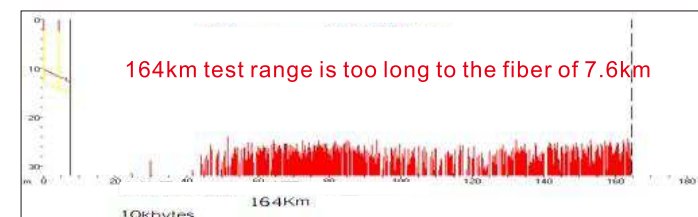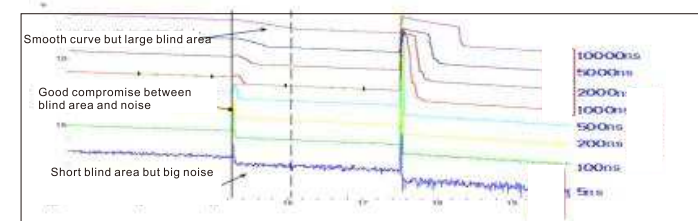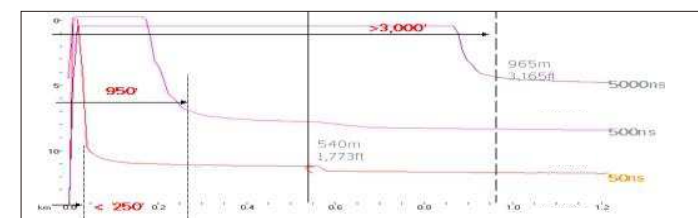

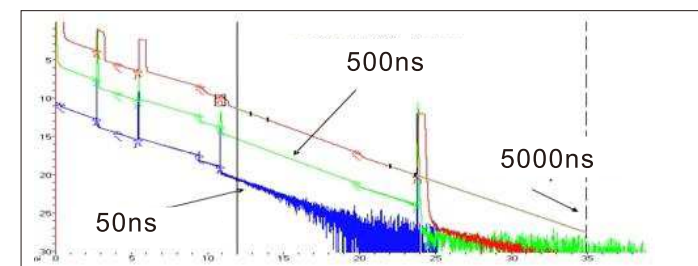
Figure 1

Figure 2

Figure 3

Figure 4

Setting proper wavelength

Proceed test with same fiber but different wavelength we will get different result. Longer the testing wavelength is,more sensitive of the bending, in below chart ,first splicing point has bending problem,splicing loss value under 1550nm is bigger than that under 1310nm. the other points are similar with 1310nm and 1550nm.This phenomenon indicate that this fiber is just bended at the first point. If it's possible please alway compare the point state under 1310nm and 1550nm and judge whether it's bended or squashed(see Figure 5).
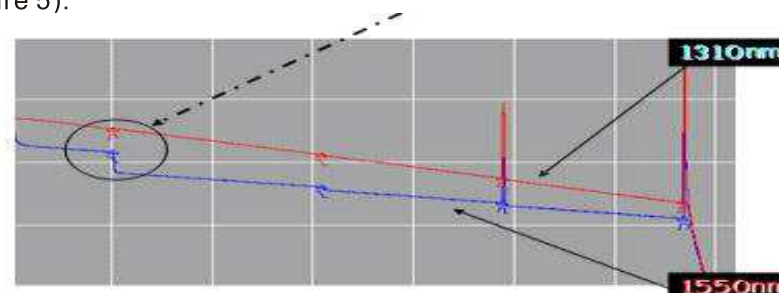

Figure 5

Setting proper test time

In averaging mode, long testing time could reduce noise during the data sampling and Improve precision to get better and smoother curve(see Figure 6).
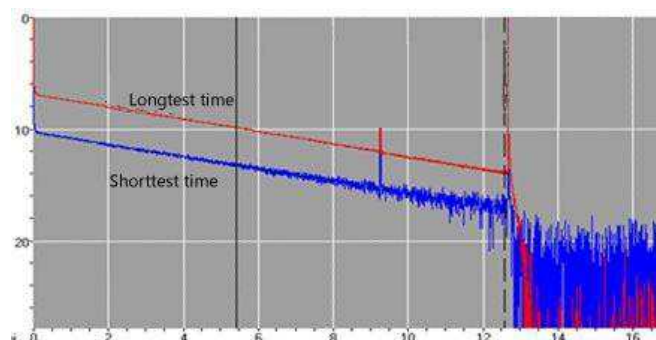

Figure 6

5.0 Expanding the Waveform and Moving the Display Area

5.1 Switching between Event List and Display Window

Original event window

In "current test" interface, press【F4】button to switch between "Curve"and "Event", expend each section after switch, this function could also switch between cursor("Curve") and selection tag("Event").
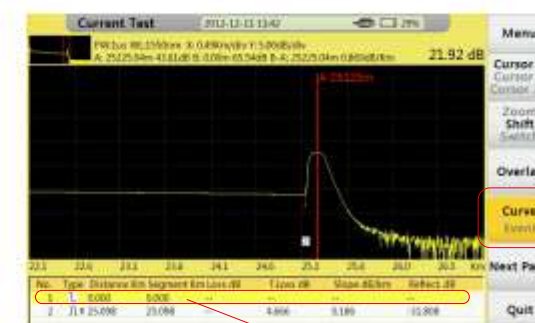
Procedure:

In test interface,

1. Press【F4】button to switch from curve to event windows.

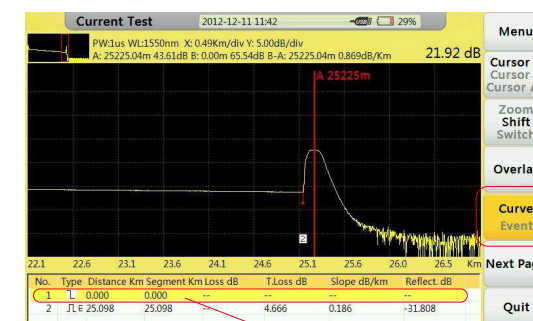2. Control【▶】/【◀】or【▲】/【▼】to move selection tag.

Event window became larger

Switch to "Event", move selection tag to choose event.

Every time move selection bar to an event in event list, cursor will move synchronously to relevant event on curve. User could use "Zoom","Move","Switch"function to adjust curve to a better position, for more information please refer next sections.
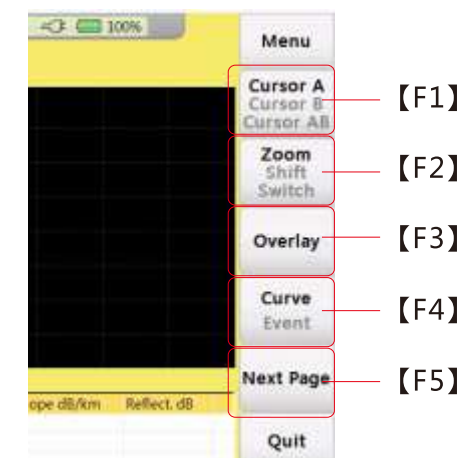

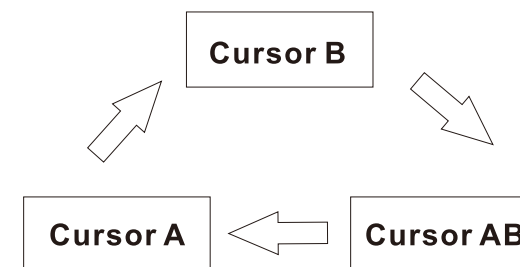Switch to "Event", move selection tag to choose event.

5.2 Cursor Operation

5.2.1 Activating Cursor

In"Current Test" interface, press【F1】button,"cursor"tag turns yellow, means it has been activated.

5.2.2 Moving Cursor

Set proper cursor, press【▶】/【◀】 button to move current cursor, long press to move cursor faster.

Cursor B

Cursor A   **Cursor AB**

Sequence of cursor switching

5.3 Curve Operation

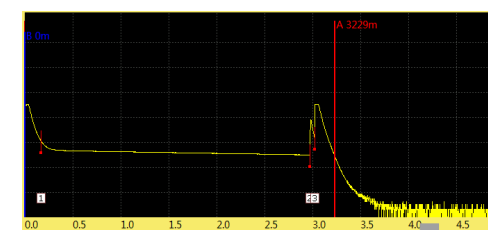### 5.3.1 Horizontal Zoom

Procedure:

In "Current Test"interface,

1. Press【F2】button to activate "Zoom"function.

2. Control【▶】/【◀】 button to zoom in or zoom out curve.

【▶】: Zoom in curve   【◀】:Zoom out curve

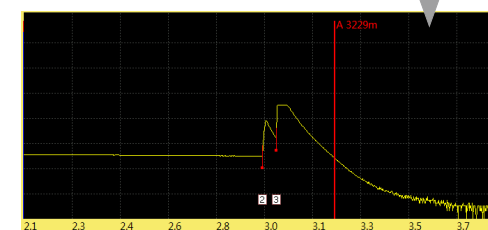**Original**

After operation

5.3.2 Vertical Zoom

Procedure:

In "Current Test"interface,

1. Press【F2】button, activate "Zoom"function.

2. Control【▶】/【◀】button to zoom in or zoom out curve.

　　【▶】：Zoom out　　【◀】:Zoom in

3. Press【OK】button to reset curve.
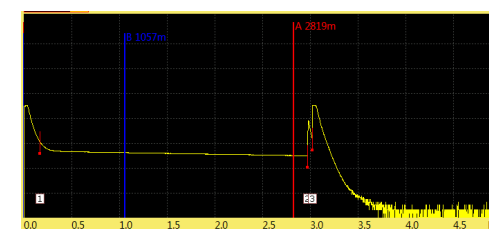
5.3.3 Horizontal Shift

Procedure:

In "Current Test"interface,

1. Press【F3】button, activate "shift "function.

2. Control【▶】/【◀】button to move right or left.

　　【▶】：move right　　【◀】: move left

3. Press【OK】button to reset curve.

Original
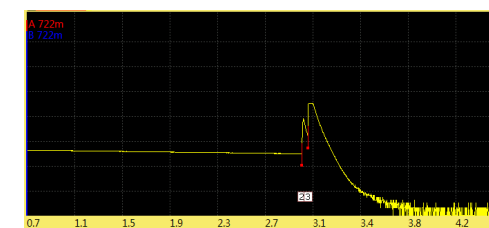
After operation

Original
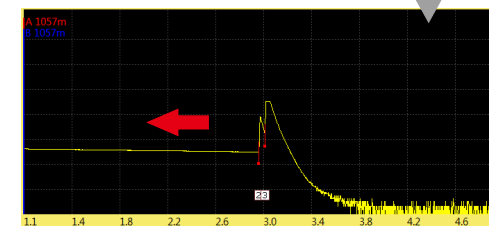
After operation

5.3.4 Vertical Shift

Procedure:

In "Current Test"interface,

1. Press【F3】button, activate "shift"function.

2. Control【▲】/【▼】button to move up or down.

　　【▲】：move up　　【▼】:move down.

3. Press【OK】button to reset curve.

5.4 Elaborating Event

This section we will introduce how to elaborate an event on curve, example as event 2 in right curve.

Procedure :

In "Current Test" interface,

1. Press【F1】button to activate cursor function.

2. Contro【▶】/【◀】lto move cursor(A or B) left or right.

3. Move to event 2.

4. Press【F2】button to active Zoom function.

5. Control【▶】button to zoom out event(cursor as the center).

6. Press【F3】button to activate"shift" function.

7. Control【▲】/【▼】/【▶】/【◀】button to adjust to a proper position.

Original

After operation

Reference point Event 1

Event 2
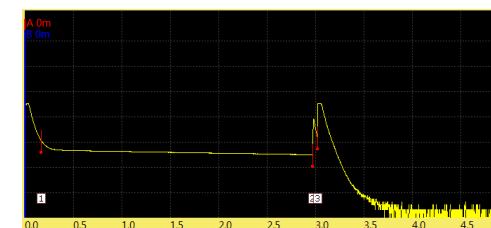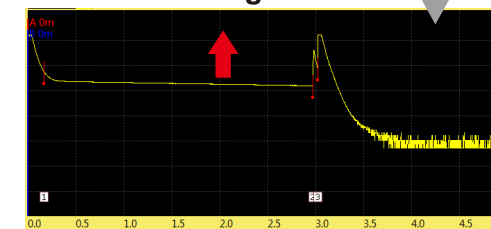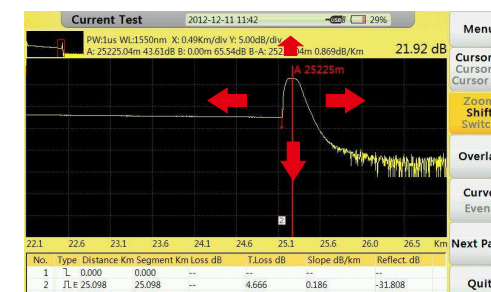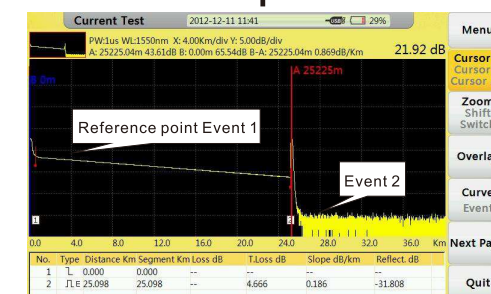
5.5 Switching between Curves

This function could used to switch between several curves ,current curve displayed in yellow.

Procedure :

In "Current Test" interface,

1. Press【F2】button , active "switch"function.

2. Control【▲】/【▼】button to switch between curves.

    【▲】:Switch to above curve 【▼】:switch to below curve

3. Press【OK】button to reset all curves

Caution

Display maximum 8 curves at one time, if load more than 8 curves last curve will recover the former one, please refer 6.2 "Loading Curve(S)" for learning how to load curve(s).

5.5.1 Removing Curve(s)

User could remove one or several curves.

Press 【F3】 "Overlay"tag menu:

● Remove Current Trace   Remove the Curve which has been selected.

● Remove Other Trace   Remove the Curve(s) which has not been selected.

● Remove All   Remove all the Curves.
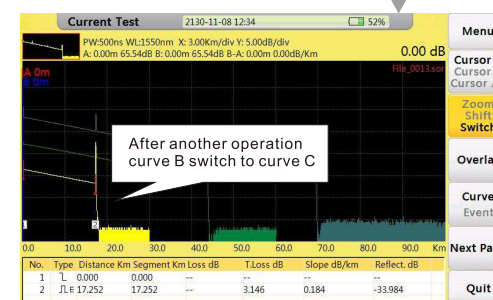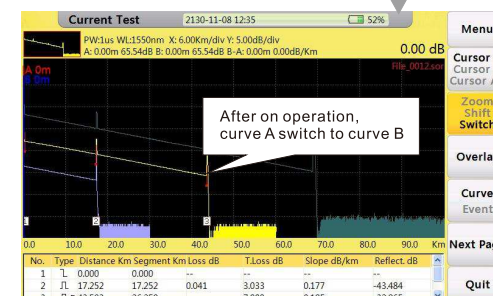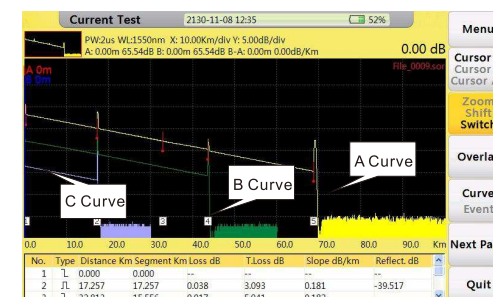
5.6 Removing an Event

Procedure:

In current Test interface,

1. Press【F1】button to activate tag, move cursor to the target event
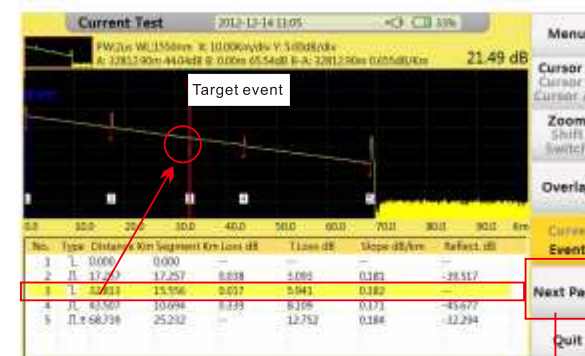
Target event

Appear by pushing"Next page"tag

3. Press【F4】"Remove Event"tag to remove event(S).   2. Press【F5】 button to select"Next Page"tag.

After operation this event in the event list disappear

After operation cursor jump to next event
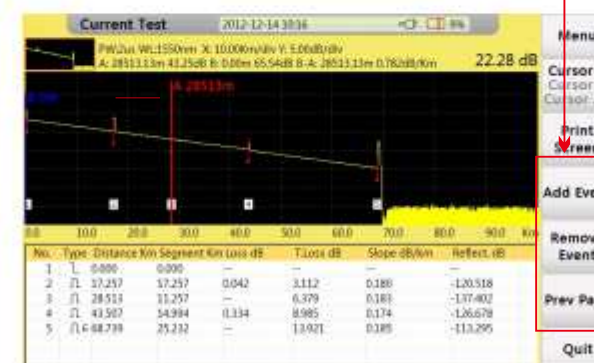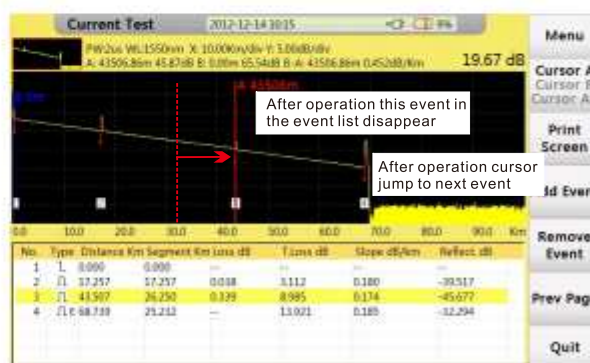
5.7 Adding an Event

Procedure:

In current Test interface,

1. Press【F1】button to activate tag, move cursor to the target event

2.Press【F5】button to select"Next Page"tag(Please refer last section5.6 "Remove an Event").

3. Press【F3】 to add event.

Caution

Event addition may not operate successfully for too close to another event, user could move cursor a bit away from near event and have another try.
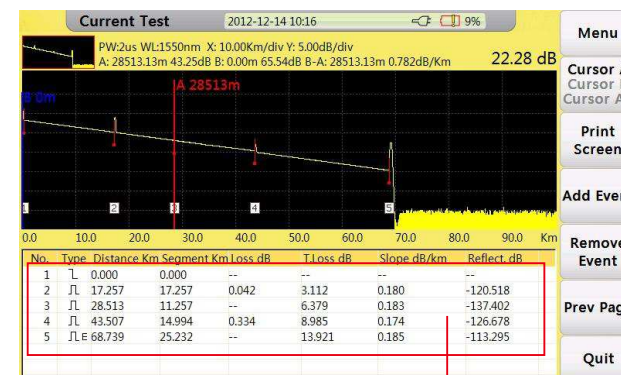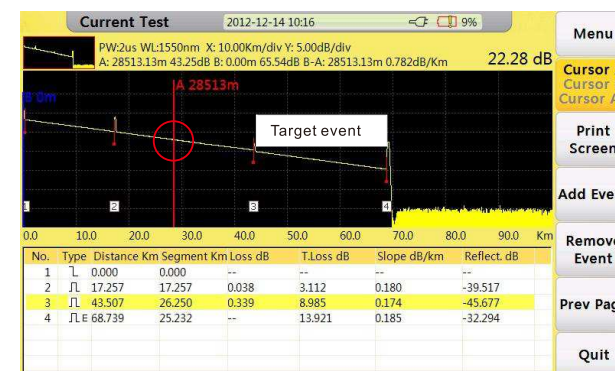
After operation ,this event will appear in the event list sequence will be rearranged.

6.0 File Operation

In "Current Test" interface Save the current curve , press【 FILE】 button on the board ,open "File Operation"interface,showed as follow:

"File Operation"interface

File Setting F5
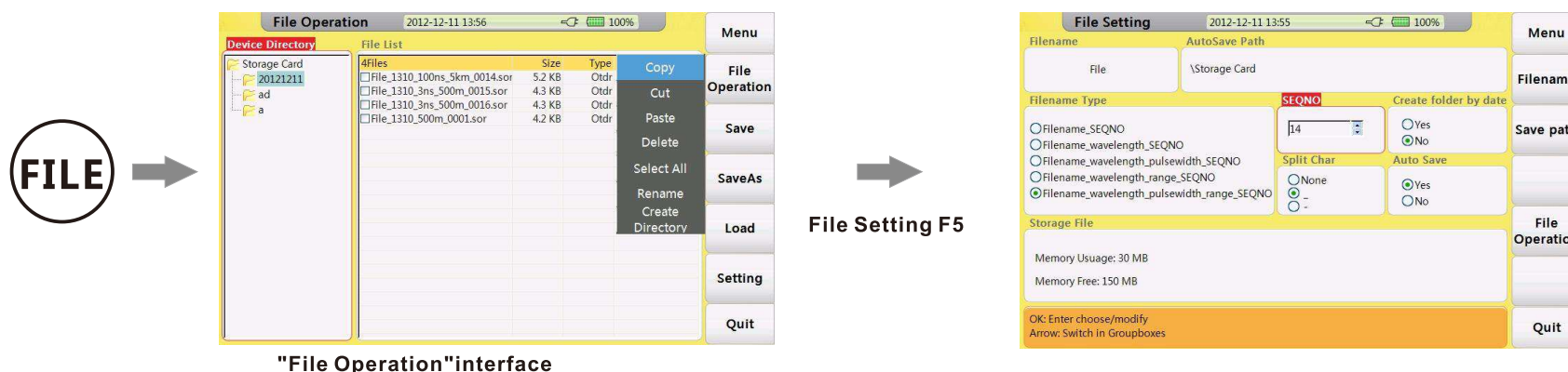
6.1 Saving Curve

Procedure:

In"Device Directory"window,

1. Press 【▲】／【▼】 to choose file and subfile then press 【OK】.

2. Press 【F5】button to enter "File Operation"interface ,user can change way of saving,decide way of naming and check storage state.

3. Press【F2】 "Save" tag to save current curve as default name(set in "Filename Type"under "File Setting"interface).

4.If user want to change a name before saving , press【F3】"Save As"tag to input your ideal name(refer section "Entering Characters" to learn how to input characters) and confirm by 【OK】button.

6.2 Loading Curve(s)

Procedure:

In"Device Directory"window,

1. Press 【▲】／【▼】to choose relative file and subfile press 【OK】.

2. Press【▶】 switch to "File list" window.

3. Control【▲】／【▼】 button to to select relevant file curve file(s),press 【OK】button to select the relevant file(s).

4. Press【F4】"Load" tag to load curve(s) .

6.3 Deleting Curve(s)

Procedure:

In "File Operation"interface,

1. Select the curve file(s) which you want to remove.

2. Press【F1】 "file operation" select "delete"sub menu to delete curve file(s).

6.4 Copying/Moving Curve(s)

Procedure:

In "File Operation"interface,

1. Select the curve file which you want to remove.

2. Press 【F1】"File operation" select "Cut" or "Copy"to move or copy curve file(s).

3. Choose the target folder, press【F1】 "File Operation" .

4. Select "Paste"tag to finish this operation.

6.5 File Setting

Tags：

Item	Description
Menu	Back to main menu
Filename	Modify prefix of file name
Save Path	Modify the save path of files
File Operation	Back to "File Operation" interface
Quit	Quit current interface

Items：

Item	Description
Filename	Prefix of file name , modify by "Filename"tag menu
AutoSave Path	Save path of auto save
Filename Type	Naming way of files after auto save
SEQNO	Sequence number of next test,and auto increment after each test
Create folder by date	Set create folder by today's date and save files separately into them
Split char	Set the type of separator
Auto save	Set Auto save
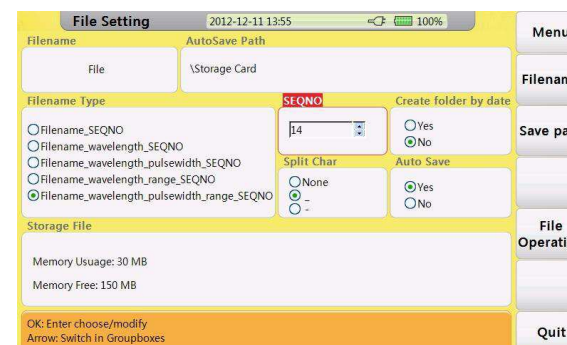
"File Setting" interface

6.6 Print Screen

FHO5000 could capture current screen and save as ".BMP"format file.

Procedure:

1. Press "Next page"tag ,under test interface.

2. Press【F1】button to capture.

User could check captured screen in "File Operation"by pushing【FILE】button.

Save Path

Caution

User could change save path under "File Setting"(refer section 6.5).

7.0 Entering Characters

You can enter file names and comments from the character input screen shown below when saving the measured waveforms.
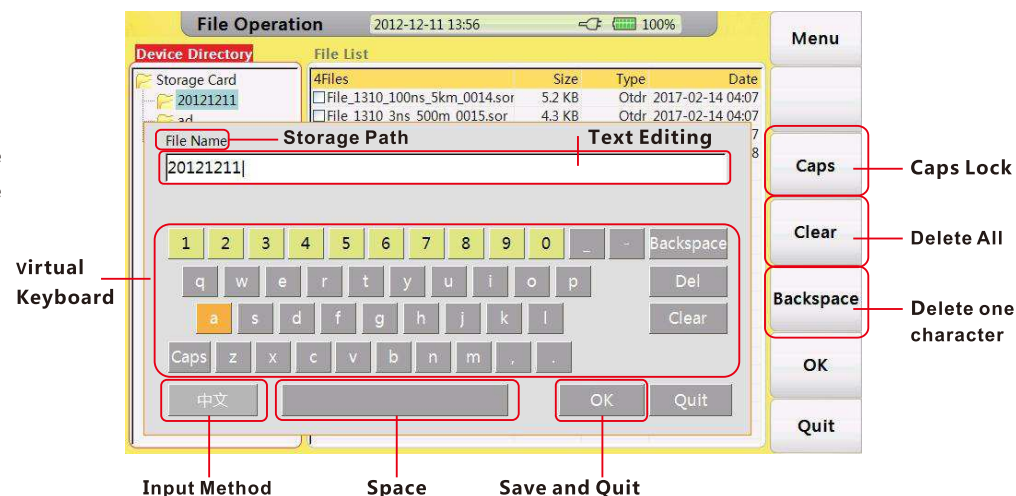
7.1 Renaming

Next guide will teach you how to change the name of file.
Procedure:
In "File Operation" interface,
1. Select your target file.
2. Press【F1】"File Operation", select "Rename".
3. Input name.
4. Confirm by "OK".

7.2 Creating Directory

Before create a folder system will inquire you to input a name.
Procedure:
In "File Operation" interface,
1. Select your target folder or root directory.
2. Press【F1】"File Operation", select "Create Directory".
3. Input name and confirm by "OK" on visual keyboard.

8.0 VFL Module

VFL module could launch visiable light to identify the fiber ,locate fault of SM or MM fibers.It is the supplementary to the testing of blind area and basic tool of optical network, LAN ,ATM fiber system and telecommunication network maintenance.
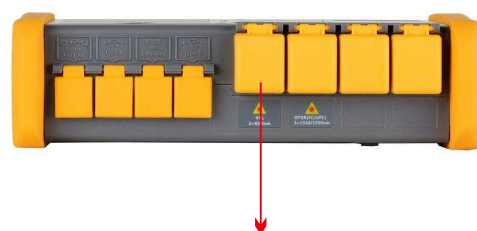
VFL launching port
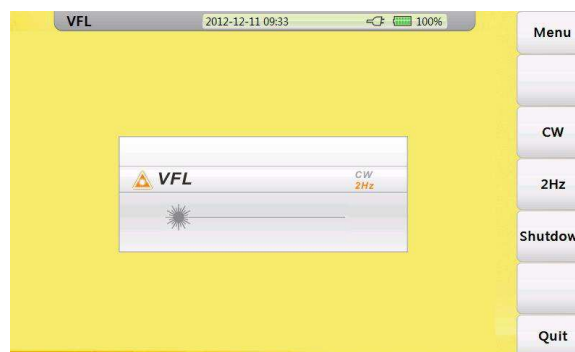
VFL interface

Warning

Don't direct the optical port to human eyes!

VFL module has two modes:
CW
Launching continuous wave(650nm)

2Hz
Launching 2Hz modulated wave (650nm)

Press "Quit" to quit VFL interface

Specification

Wavelength	650nm
Power	10mw
Modulation	CW/2Hz
Adapters	FC

9.0 OPM Module(Optional)

User could use OPM module to measure the power value in optical network and get the loss of the line with optical light source.

OPM interface

Setting
    Set offset value and Display precision
Reference value
    Press"REF"to set current power value as reference value
Wavelength switch
    Press "WL switch"to switch wavelength
Mode switch
    Press"Common/WL Recognize"to switch between normal mode and WL recognizing mode.

Specification

Sensor Type	InGaAs
Wavelength Range	800~1700nm
Calibrated Wavelength	850/1300/1310/1490/1550/1625nm
Testing Range	-50~+10dBm
Resolution	0.01dB

10.0 OLS Module(Optional)
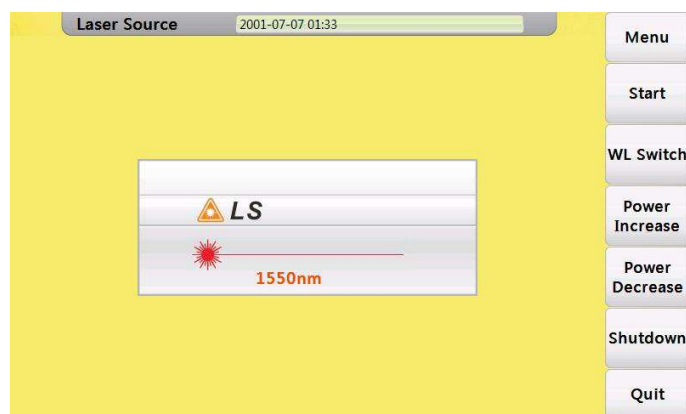
OLS Module interface

Start
   Turn on the laser source
WL switch
   Switch between wavelengths
Power Increase
   Increase the power value
Power Decrease
   Decrease the power value
Shutdown
   Turn off the laser source

Specification

Working wavelength	850/1300/1310/1550/1625nm①
Output power	-25~0dBm
Accuracy	±0.5dB

① 1310/1550nm wavelength use OTDR1 port, while 1625nm or 850/1550nm wavelength use OTDR2port, OTDR can not use 1620nm or 850/1550nm without OTDR2 module

11.0 FIM Module(Optional)

FIM Module is qualified for field connector inspection by connecting a probe to USB port, also this probe can use computer as a display with no additional software.
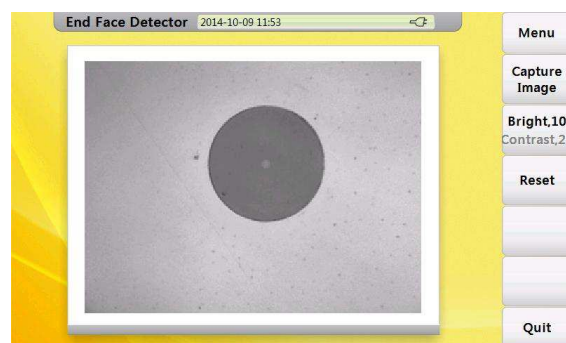
FIM Module Interface

Capture Image
  Save current image

Bright/Contrast
Adjust Bright and Contrast for image

Reset
  Recover to factory settings

Specification

Magnification	400X
Resolution(μm)	1.0
View of Field(mm)	0.40*0.31
Storage/working Condition	-18℃~35℃
Dimension(mm)	235*95*30
Sensor	1/3 inch 2 million of pixel
Weight(Kg)	0.15
USB	1.1/2.0

12.0 Waterproofing work(Optional)

Through special process, FHO5000 can compliance with IPX5 protection level. This could make FHO5000 withstand harsher environments.Test for the ratings IPX5 address the possibility of water ingress from a jetting stream.They are conducted using a jet nozzle kit .

13.0 Touch Screen (Optional)

After slelect this optional module ,a Resistance Screen will be added to FHO5000,user could select item or input words by just touch the relvent area,a specialized pen is attached.

Calibration

Once you cann't touch the certain point you want on screen that means you need to calibrate the touch screen.

Please follow next procedure to proceed calibration:

⚠️ **Warning**

Press gently on the screen, any strike or crash may damage it.

1. Open"system setting"interface and select "Touch Screen Calibration"area,enter calibration interface.

2. Follow the direction, press"+"icons on the screen,then calibration done.
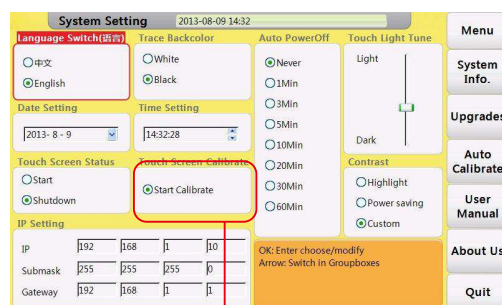
Start calibration from here
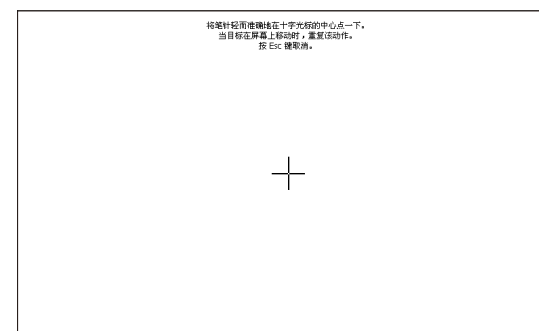
14.0 Software Update

FHO5000 could proceed update by one U disk(with patch storage in root directory).
Procedure:
1.Download patch from PC and storage into U disk(must storage in root directory).
2. Insert U disk into USB port.
3.Turn on FHO5000, press【F5】to enter system setting,press【F2】 to proceed upgrades.
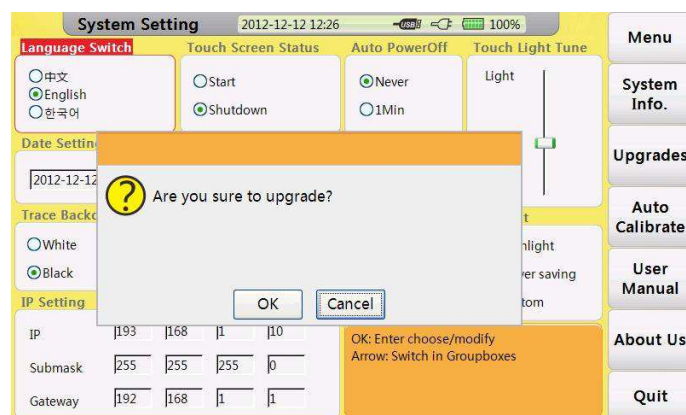
Upgrades interface1

Upgrades interface2

15.0 Background Information on Measurements

15.1 Viewing the Optical Pulse Measurement Waveform

*See the next page for the definitions of terminology
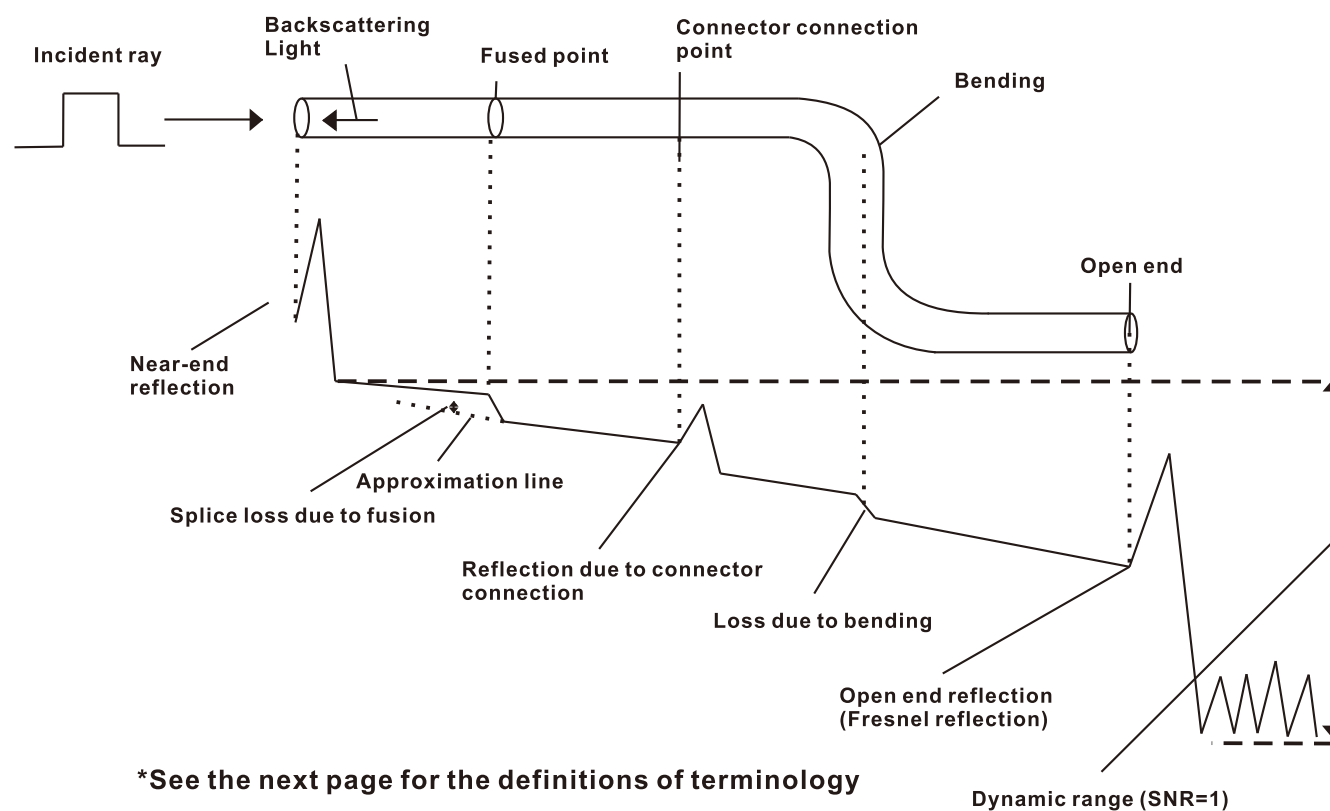
15.2 Terminology

Near-end reflection

A reflection occurs in the gap between OTDR and the connector for the optical fiber cable. Losses and reflections of the connection points cannot be detected in the section in which this reflection is detected. This section is called a dead zone.

Backs cattering light

When light propagates through the optical fiber cable, a phenomenon called Rayleigh Scattering occurs due to the nonuniformity of the density or constituents of materials smaller than the wavelength unit. The scattered light that is transmitted opposite to the direction of propagation is called backscattering light.

Splice loss due to fusion

A splice loss occurs at the fused section mainly due to axis offset and angle offset.

Reflection due to connector connection

Unlike the fused section, a slight gap occurs in the connection section of connectors. Because the group refraction index changes in this gap, a reflection occurs causing a loss.

Fresnel reflection at the far end of the optical fiber cable

Fresnel reflection occurs at the location where the optical fiber cable is broken or a location where the group refraction index changes such as the far end of the cable (glass and air) when light enters the cable. If the end face of the optical fiber cable is vertical, approximately 3.4 % (−14.7 dB) of the incident light power is reflected.

Dynamic range

Dynamic range refers to the difference between the backscattering light level at the near end and the noise (RMS = 1).

Dead zone

The locations where measurements cannot be made due to the effects of Fresnel reflection, connection point of connectors, etc.

16.0 Maintenance

16.1 Notice

FHO5000 OTDR Use rechargeable Li-ion battery.

Pay attention to the following:
- Keep OTDR dry and clean store at room temperature($15℃$~$30℃$).
- Charge it monthly if you don't use it for a long time(more than one month).
- Keep Optical port clean by alcohol soaked cotton and recover dust cap after use.
- Clean optical port and connector at fixed period .

Follow the principles below before cleaning:
- Shut off before cleaning.
- Any operations contrary to the instructions may result in dangerous laser injuries.
- Disable laser launching before cleaning.
- When the instrument is in operation, please always avoid looking directly into optic output. Although laser radiation is invisible, it may do serious injury to eyesight.
- Be cautious of electric shock and make sure AC power is disconnected from the instrument before cleaning. Always use dry or moist soft cloth to clean the outside of the instrument, and never touch inside.
- Don't proceed any modification on OTDR.
- For maintenance, please always operated by qualified worker.

16.2   Cleaning Tools

- Optic fiber cleaner (for cleaning of optic connectors)
- Optic fiber cleaning rod (for cleaning of optic outputs)
- Optic fiber cleaning tissue (for cleaning optic interfaces)
- Isopropyl alcohol
- Cotton ball
- Paper tissue
- Cleaning brush
- Compressed

Structure of optical port

16.3   Cleaning of Optical Port

Procedure:

1. Screw down the cap.
2. Pull out ceramic core by fingers.
3. Clean port carefully.
4. Recover ceramic core.
5. Screw on the cap.

16.4   Calibration

We suggest to calibrate FHO5000 OTDR twice a year, for more information please contact us(check section 17.4 "Customer Service and Support" to find our contact information).

Caution

Be careful, don't use tools like plier, it may cause permanent damage to optical port

17.0 Diagnosis Center

17.1 FAQ

Fault	Reason	Solution
Can't turn on	1.Holding time on power button is not enough(>2s). 2.Run out of power / battery has broken. 3.No battery. 4.Too cold there.	1. Long press on ON/OFF key. 2.Connect external power/ Replace a new battery. 3.Install battery. 4.Change another environment.
Display shows nearly nothing after turned on	1.Brightness need to be adjusted. 2.Connection between display and motherboard is not good.	1.Adjust brightness. 2.Open and reconnect.
Battery does not work properly	1.Temperature is too high. 2.Connection is not proper. 3.Battery is nearly broken.	1.Try to decrease temperature. 2.Reconnect battery. 3.Replace a new one.
Power state indicator turns yellow	Battery has broken	Replace a new one
Measuring graphic only has front end reflection	1.Connector loose, polluted, damaged or unmatched. 2.Locating pin has broken.	1.Clean and reconnect. 2.Change a new adapter.
No response		Restart
Find Ghost	1. Often happened in large plus width, long range and short link condition. 2.Common ghost caused by continuous reflection of connector.	1.Use proper measuring range and pulse width setting. 2.Reconnect fault point of Reflection event, reduce reflection strength.

17.2   Help Information

FHO5000 has an build-in manual with essential information.
Procedure:
  Turn on OTDR,
  1.Press【F5】enter system setting,press【F4】to read manual
     Control 【▲】／【▼】button to flip over.
  2.Press 【Esc】 to quit.
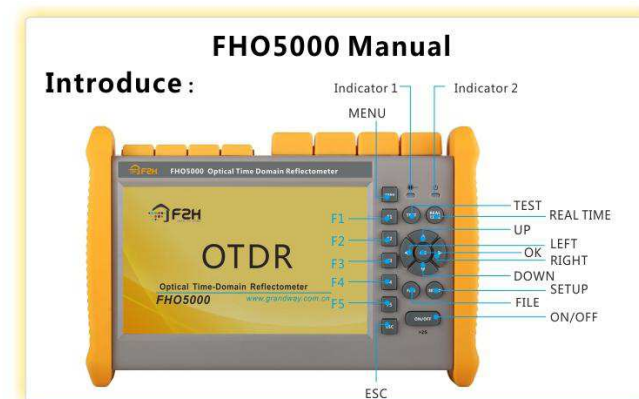
18.0 Specification

18.1   Physical Parameter

Display	7inchTFT-LCD(touch screen is optional)
Working temperature	-10~+50°C
Storage temperature	-20~+75°C
Humidity	<95%
Dimension	253X168X73.6mm
Weight	1.5kg(with battery)
Battery	7.4V/4.4Ah lithium battery
Battery working temperature	-10~+50°C
Battery storage temperature	-20~+70°C
Working hours	6hours(Condition: Full power,70% brightness, realtime mode)
Battery life time	>500times
Power	DC9~12V 4A
Charging time	4-5hours
Shock resistance	Bear 1.2m free fall

18.2 Test Parameters

Type①	Testing wavelength	Dynamic range②	Event/Attenuation dead-zone③
FHO5000-M21	850/1300nm	21/19dB	1.5/8m
FHO5000-MD21	850/1300/1310/1550nm	21/19/35/33dB	1.5/8/1.5/8m
FHO5000-D32	1310/1550nm	32/30dB	1.5/8m
FHO5000-D35	1310/1550nm	35/33dB	1.5/8m
FHO5000-D40	1310/1550nm	40/38dB	1.75/11m
FHO5000-D43	1310/1550nm	43/41dB	2/14m
FHO5000-D45	1310/1550nm	45/43dB	2/14m
FHO5000-T40/T40F	1310/1550/1625nm	40/38/38dB	1.75/11m
FHO5000-T43/T43F	1310/1550/1625nm	43/41/41dB	2/14m
FHO5000-T45/T45F	1310/1550/1625nm	45/43/43dB	2/14m

Test parameter

Pulse width	3ns, 5ns, 10ns, 20ns, 50ns, 100ns, 200ns, 500ns, 1μs, 2μs, 5μs, 10μs, 20μs
Testing distance	Dead zone test(100m), 500m, 2km, 5km, 10km, 20km, 40km, 80km, 120km, 160km，240km
Sampling resolution	Minimum 0.25m
Sampling point	Maximum 128,000 points
Linearity	≤0.05dB/dB
scale indication	X axis: 4m~70m/div, Y axis:0.09dB/div
Loss threshold	0.01dB
Loss resolution	0.001dB
Distance resolution	0.01m
Distance accuracy	$\pm(1m+measuring\ distance \times 3 \times 10^{-5}+sampling\ resolution)$
Refractivity Setting	1.4000~1.7000, 0.0001 step

VFL Module

Wavelength	650nm
Power	10mw,CLASSIII B
Range	12km
Connector	FC/UPC
Launching Mode	CW/2Hz

OPM Module(Optional)

Sensor Type	InGaAs
Wavelength Range	800~1700nm
Calibrated Wavelength	850/1300/1310/1490/1550/1625nm
Testing Range	-50~+10dBm
Resolution	0.01dB
Accuracy	±0.35dB±1nW
Adapter	FC/UPC

OLS Module(Optional)

Working wavelength	850/1300/1310/1550/1625nm④
Output power	-25~0dBm
Accuracy	±0.5dB
Connector	FC/UPC

FIM Module(Optional)

Magnification	400X
Resolution	1.0µm
View of Field	0.40×0.31mm
Storage/working Condition	-18~35
Dimension	235×95×30mm
Sensor	1/3 inch 2 million of pixel
Weight	150g
USB	1.1/2.0
Adapter⑤	SC-PC-F(For SC/PC connector)
	FC-PC-F(For FC/PC connector)
	LC-PC-F(For LC/PC connector)
	2.5mm -Male (For 2.5mm adapter)

① Model T40F/T43F/T45F are intergrated with optical filter, this allow them to test PON network online(use 1625nm wavelength) and will not interrupt the fiber signal.
② Dynamic range is measured with maximum pulse width,averaging time is 3 minutes
③ Event dead zone is measured with minimum pulse width
④ 1310/1550nm laser source use OTDR1 port, 1625nm uses OTDR2port, 1625nm or 850/1300nm uses OTDR3 port..
⑤ For more adapters please contact us

18.3 Dimension

Top view

Unit:mm
Except where noted, tolerance default as:±3%
(if size<10mm, tolerance:±0.3mm)

253

Front view

168

73.60

Side view

19.0 Warranty

19.1 Terms of Warranty

All GRANDWAY products are warranted against defective material and workmanship for a period of time from the date of shipment to the original customer. Any product found to be defective within the warranty period would be repaired or replaced by GRANDWAY free of charge.In no case will GRANDWAY liabilities exceed the original purchase price of the product.

19.2 Exclusions

The warranty on your equipment shall not apply to defects resulting from the   following:
- Unauthorized repair or modification
- Misuse, negligence, or accident
- GRANDWAY reserves the right to make changes to any of its products at any time   without having to replace or change Previously purchased units.

19.3 Transportation

To return instrument for reasons of yearly calibration or other, please contact us. to obtain additional information and RMA#code(Return Materials Authorization number). And describe briefly reasons for the return of the equipment, to allow us offer you more efficient service.

To return the instrument in the case of repair, calibration or other maintenance, please note the following:

- Pack the instrument with soft cushion like Polyethylene, so as to protect the shell of the instrument.
- Please use the original hard packing box. If use other packing material, please ensure at least 3 cm soft material cover around the instrument.
- Be sure to correctly fill out and return the warranty registration card, which should including following information: company name, postal address, contact, phone number, email address and problem description.
- Seal the packing box with exclusive tape.
- Ship to your representative or the agent of the Company in a reliable way.

19.4 Customer Service and Support

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