FHO1500 Last Mile Explorer User Manual
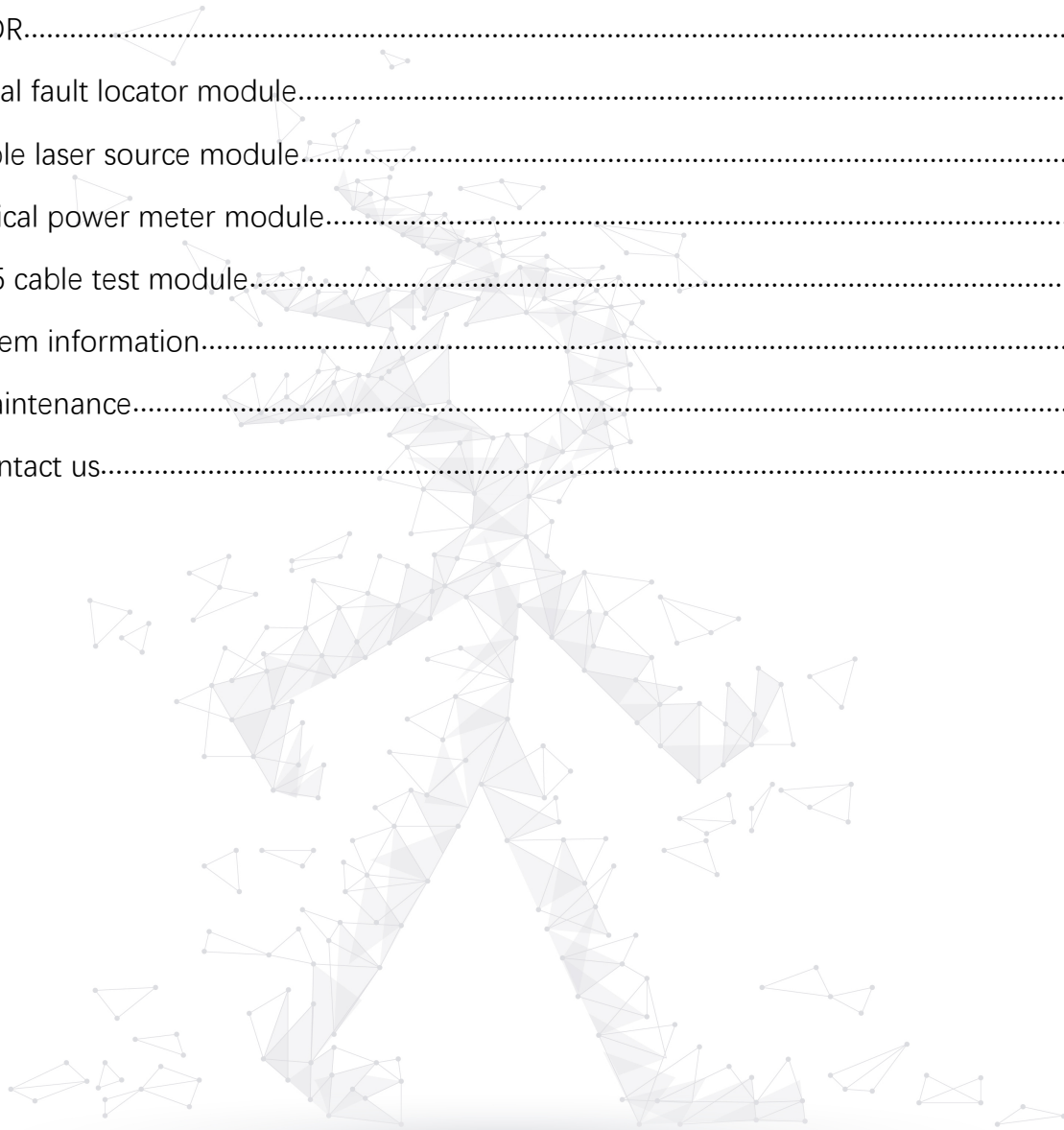
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Shanghai Grandway Telocom Tech.Co.,LTD

800-819-8191 400-619-8191

Content

1 Safety precautions

1.1 Battery

In order to prevent battery problems, please charge and discharge the battery regularly.

Please pay attention to the change of surrounding environment when charging the battery, otherwise leakage, smoke, explosion and even fire may occur.

Only the built-in lithium battery specially designed for the instrument can be used. Do not use other types of batteries. Please use the charger specified by Grandway company for charging. If the charging is not completed within the specified time, please stop charging immediately. Because the electrolyte inside the battery is alkaline, if the battery leaks or breaks and comes into contact with the electrolyte, it will damage clothes and skin. If electrolyte gets into the eyes, it may cause blindness. In case of such an accident, please wash your eyes thoroughly with clean water immediately and see an ophthalmologist immediately. In order to prevent electric shock explosion accident, do not put the machine into fire or heat it, it will explode.

1.2 Electrical safety

Use the correct power supply

Before connecting the power line, please make sure that the power supply voltage is the rated voltage of the charging adapter, and the maximum voltage should be less than the rated voltage that the power line can withstand.

Use the correct power cord and charging adapter

Please use the attached power cord and charging adapter, do not use other power cord and adapters.

1.3 Laser safety

Do not aim the laser emitter at human eyes, otherwise it may cause permanent and irreversible damage.

Do not look directly at the laser, do not touch the light directly emitted by the laser, the light reflected by the mirror, or the light incident through a specific eye shield. In addition, please avoid direct exposure to laser, it will cause eye damage and blindness, it is best to use the cover to cover the unused optical interface.

1.4 Inflammable and explosive

Don't use it in the place with inflammable and explosive gas

Please use the instrument in legal and safe places. Do not use the instrument in places with flammable and explosive gas or steam.

Don't remove the protective jacket of the instrument

Do not remove the instrument cover or replace the internal components. If necessary, please contact our maintenance personnel.

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2 FHO1500 Mobile phone software

By scanning the following QR code to download the Android mobile application of FHO1500, the test file of OTDR can be quickly transmitted to the mobile phone through the FHO1500 software, and the OTDR can also be controlled by the mobile phone for testing. The analysis of the OTDR curve on the mobile phone will make it more convenient to enlarge and narrow the curve.

FHO1500 Android software QR code
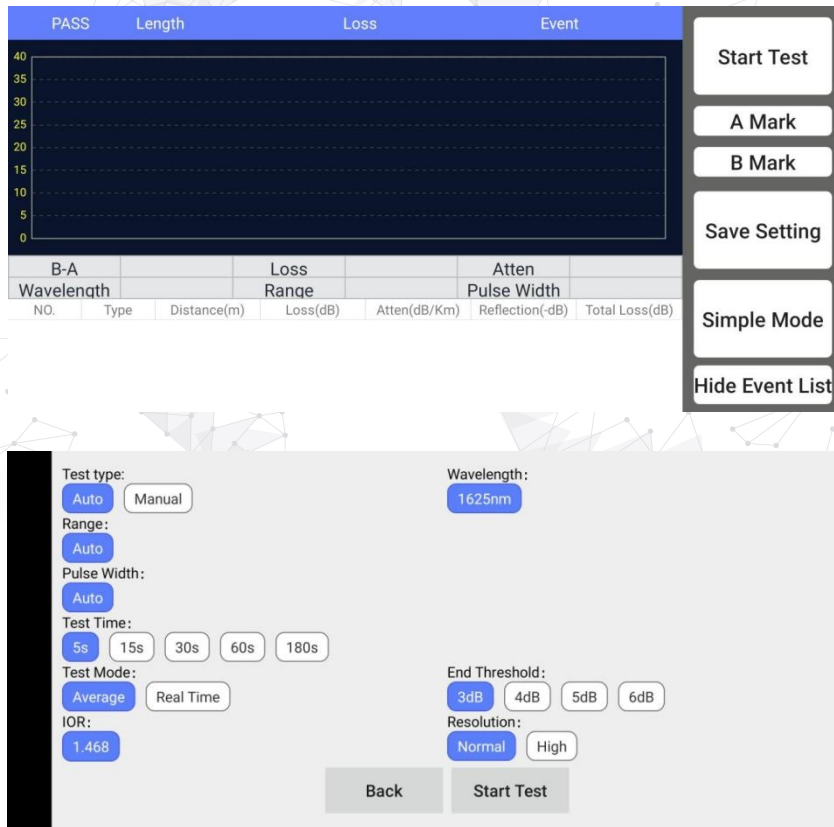
FHO1500 mobile phone software screen

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3 Product description

3.1 Product positioning

FHO1500 optical time domain reflectometer is a new generation of intelligent optical fiber network measuring instrument, which is elaborately developed and produced by our company, and has gone through strict quality control process of mechanical, electronic and optical inspection before leaving the factory. It can measure the total length, total loss, return loss and distance between any two points of optical fiber and optical cable, and determine the location of connection point, splice point, fault point and breakpoint of optical fiber and optical cable.

The main features of the instrument are: integrated design, novel appearance, strong and durable; small size, light weight, easy to carry; can easily test the loss, length and fault location of optical fiber link; the machine has a visual fault location system, which can easily detect the fault location in the optical fiber line; the working time of the battery in the machine is long, which is suitable for long-time field operation.

The instrument is widely used in the detection of fiber loss and fiber fault location in engineering construction and maintenance. Main functions of the instrument are below:

- Test the total length and total loss of optical fiber
- Test the distance between any two points on the optical fiber curve
- Test and display the loss between any two points on the curve(dB) and fiber attenuation constant(dB/km)
- Test and display the connection loss of the connection point on the curve and the attenuation loss of the fusion point (dB)
- Test reflection loss value
- Automatic search function of connection point
- Real time test function, convenient to observe the real-time docking effect of optical fiber
- Intelligent battery power indicator function
- Test curve storage: test curve data can be stored in local memory
- Support Bluetooth connection with mobile phones, and quickly transfer test files to mobile phone
- It supports remote control of mobile phone, and remote operation and control of OTDR through mobile phone app
- 10mw VFL function
- Stable laser source function
- Optical power meter function
- Line sequence measurement of RJ45 cable

3.2 Appearance size

Front view   Side view   Back view

Size：192.9×93.8×47mm

3.3 Keypad description

Name	Function
F1-F4	Enter the corresponding menu
TEST	Used for OTDR average test and real-time test
Enlarge button	Used to enlarge the OTDR curve
Navigation button	Used to control up, down, left and right cursor movement

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OK button	Used to confirm selection and 1:1 restore curve
ESC	Exit current menu
ON/OFF button	Long press/short press for more than 2s to turn on/off

3.4 Interface description

Top interface

Name	Function
OTDR interface	OTDR test port and laser source test port share OTDR test port
OPM interface	2.5mm universal optical power meter test port
VFL interface	2.5mm universal VFL test port
SD card interface	For installing SD card
RJ45 interface	Used for IP testing, such as PING testing and firmware upgrade

Bottom interface

Name	Function
USB interface	Type-C charging interface
RJ45 interface	Remote module for measuring RJ45 cable line sequence
RJ45 interface	Test interface for measuring RJ45 cable line sequence

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3.5 Rear panel description

Name	Function
OTDR information	Display the factory information of the device, including device name, product model, production date, Bluetooth Mac, serial number, etc

3.6 Packing list

1、OTDR main unit	2、Carrying bag	3、USB charging cord	4、Charging adapter
5、User manual	6、Test report		

3.7 Power on display

Name	Function
OTDR	Enter the corresponding OTDR function menu
VFL	Enter the corresponding VFL function menu
Stable laser source	Enter the corresponding stable laser source function menu
Optical power meter	Enter the corresponding optical power meter function menu (Include the 10G PON 1490nm/1577nm power meter)
RJ45	Enter the corresponding RJ45 cable line sequence test function menu
Setup	Enter the corresponding OTDR system setting menu

4 OTDR

4.1 OTDR brief introduction

4.1.1 OTDR basic principles

The full English name of OTDR is optical time domain reflectometer, OTDR is a precise photoelectric integrated instrument which is made by using the Rayleigh scattering and the backscattering generated by Fresnel reflection when light is transmitted in optical fiber. It is widely used in the maintenance, construction and monitoring of optical cable lines, and can measure the length of optical fiber, transmission attenuation of optical fiber, joint attenuation and fault location.

Rayleigh scattering

Rayleigh scattering occurs when the pulse travels down the fiber and some small changes in the material (such as changes in refractive index and discontinuities) cause light to scatter in all directions. A part of the light is scattered back along the opposite direction of the pulse, so it is called Rayleigh backscattering. The backscattered light provides the attenuation details related to the length. The information related to length is obtained through time (i.e. the origin of time domain in OTDR). These backscattered signals indicate the degree of attenuation (loss / distance) caused by the fiber. The curve formed is a downward curve, which reflects the transmission characteristics of the fiber.

Fresnel reflection

Fresnel reflection occurs when the light passing down the optical fiber encounters a sudden change in material density. The change of material density may occur at the junction or fracture with air gap. This phenomenon is used by OTDR to accurately locate the position of discontinuities along the length of the optical fiber. Compared with Rayleigh scattering, Fresnel reflection can reflect a considerable amount of light, and the power of Fresnel reflection is tens of thousands of times of that of backscattering. The intensity of reflection depends on the change of refractive index.
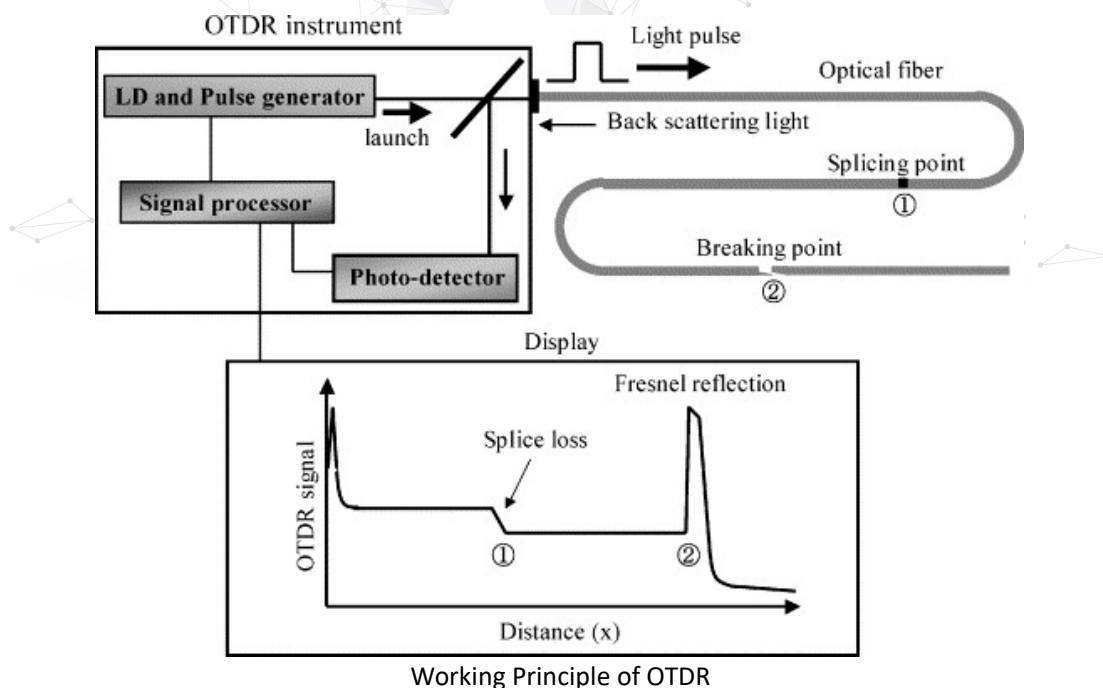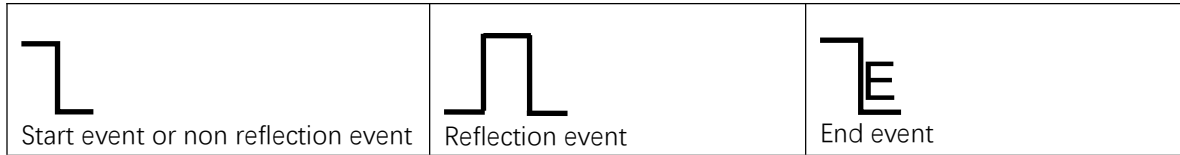
OTDR distance test

The formula of OTDR is: distance = $[C / N] \times [T / 2]$

C = speed of light in vacuum (3×10^8 / s)

T = time delay between transmitted pulse and received pulse

N = refractive index of the fiber under test (specified by the manufacturer)

Working Principle of OTDR

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 an 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.

4.1.2 OTDR measurement content

- The total length and total loss of optical fiber
- The distance between any two points on the optical fiber curve
- Test and display the loss and distance between any two points on the curve(dB) and fiber attenuation constant(dB/km)
- Test and display the connection loss of the connection point on the curve and the attenuation loss of the fusion point (dB)
- Test reflection loss value
- Automatic search function of connection point

4.1.3 OTDR curve analysis

OTDR is a fully automatic analysis process for curves, which is located as follows:

- The reflection events generated by connector and mechanical joints;
- Non reflection event (usually fusion joint);
- Optical fiber end: through scanning the first loss event greater than the end threshold, OTDR detects it as the end of optical fiber;
- Event list: event type, loss, reflection and distance are calculated and listed.

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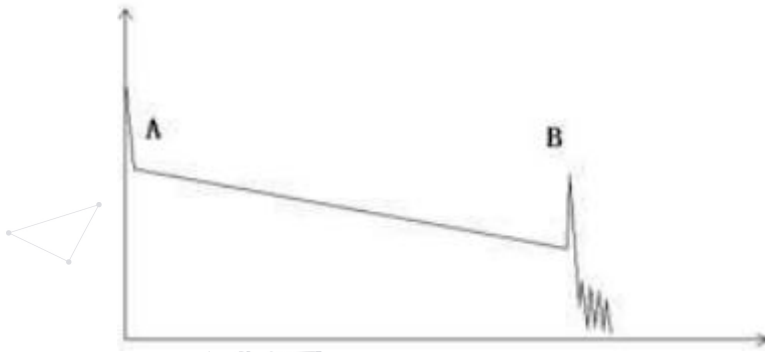
A normal trace shows as above, the A mark is a start-peak and the B mark is a end-reflection-peak. The tested trace is oblique, the total loss will become bigger with the increasing of the fiber length. The total loss(dB) divides total length is the average loss(dB/km) of a fiber.

Curve with Jumper Connected
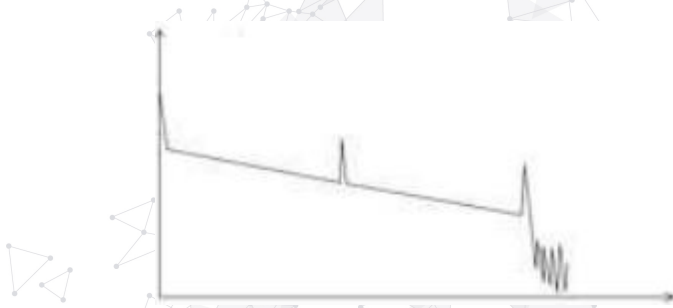
If there is additional reflection peak in a tested trace, this may be caused by a connection point or some other reasons. Anyway, appearance of the reflection peak shows that the two connecting surfaces of the connection are smooth. The smoother the connection surfaces are, the higher the reflection 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.
3. If the problem still exists, we could estimate:
4. The connector of the test fiber is broken or polluted.
5. The launching port on the OTDR is broken or polluted.
6. 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
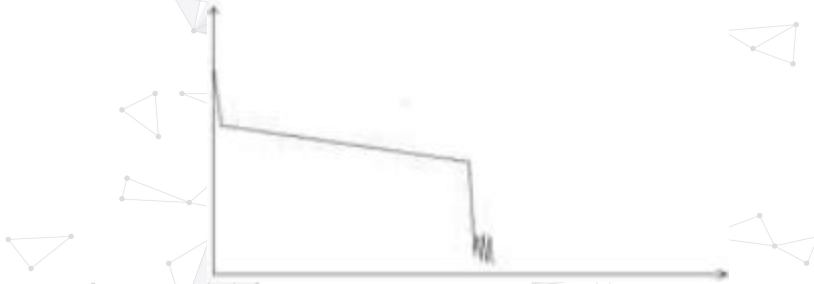
The situation that there is no reflection peak at the end of a trace shows above should be paid attention on. If the distance of the tested fiber is available and the distance shown on OTDR is not equal to the original distance, this shows that the fiber might be broken down or twisted and the bending 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.
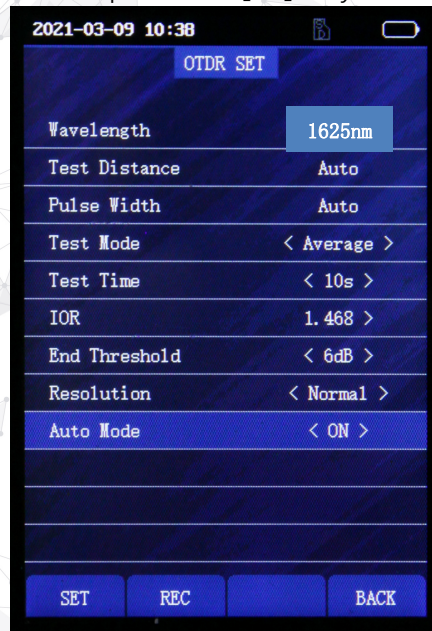
Distance is Too long

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.

4.2 Parameter setting

Enter the OTDR function menu and press the 【F1】 key to display the following interface:

The following is the meaning of each menu in the interface:

Wavelength	OTDR can emit the wavelength of light wave, single 1625nm or 1650nm is optional.
Test distance	The test distance of OTDR test is about 1.5-2 times of the actual test fiber length. It can only be modified in manual measurement mode. The default value is "automatic configuration" in automatic mode Selection of test distance: 1km, 2km, 5km
Pulse width	Pulse width refers to the duration of the optical pulse signal injected into the measured fiber in a period of time. The wider the pulse width is, the longer the light-emitting time of OTDR laser is, the stronger the transmitting signal power is, and the farther the effective detection distance of OTDR is. However, the wide pulse width will cause the saturation of the initial reflection signal and large deadzone area. Therefore, the choice of pulse width is related to the length of optical fiber. The longer the length is, the wider the pulse width is. It can only be modified in manual measurement mode. In automatic mode, it is "automatic configuration" by default.

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	Pulse width selection: 5ns, 10ns, 30ns
Test mode	Average mode: OTDR enters the average test mode, which is applicable to accurate analysis of optical fiber lines Real time mode: OTDR enters real-time test mode, which is applicable to fast analysis of optical fiber lines
Test time	In average test mode, the longer the detection time is, the better the signal-to-noise ratio is and the more accurate the test result is. Users should choose the test time reasonably. Test time selection: 5s, 10s, 15s, 30s, 60s, 120s
Refractive index (IOR)	The refractive index parameter of the optical cable, the factory default refractive index is 1.468.
End threshold	It is used to judge the threshold value of fiber test terminal Fiber end threshold: 3dB/4dB/5dB/6dB
Resolution	High resolution will have more sampling points and higher accuracy, but it will also increase the amount of data collected. There are standard resolution mode and high resolution mode
Auto mode	Auto mode on: the equipment will automatically set the most appropriate parameters for the current measurement, and the value of measurement range and pulse width selection cannot be modified. Auto mode off: the test distance and pulse width selection can be set manually.
Recovery	Recovery factory default parameter value

4.3 Perform the OTDR test

4.3.1 Set test mode

FHO1500 has two test modes, average test mode and real-time test mode.
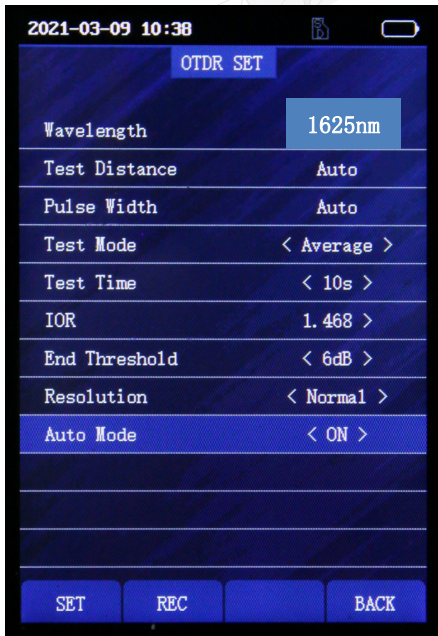
Average test mode

The average test mode will display the curve composed of the average values of the measured values over a period of time. The test time can be edited in the "test time" menu in the "test settings" interface.

In the test settings, select the test mode as "average" mode, click the main key "Test" to enter the average test interface, and carry out the average test according to the set test time.

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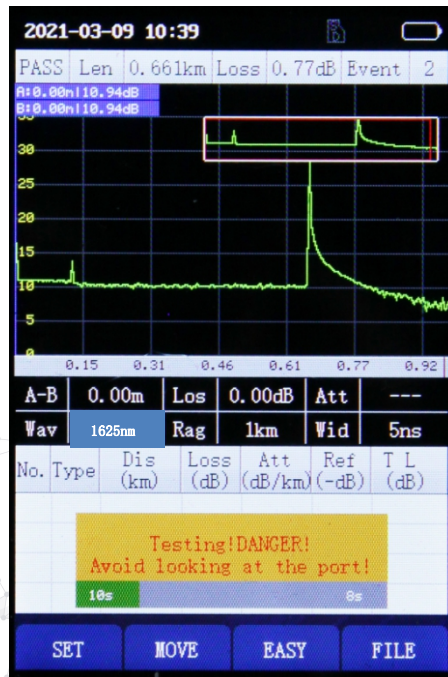
Real-time test mode

Real time test mode, you can view the test curve in real time and quickly detect the characteristics of the optical fiber link.

In the test setup, select the test mode as "real-time" mode, and click the main key "Test" to enter the real-time test interface. At this time, OTDR will continuously emit pulse light for real-time test
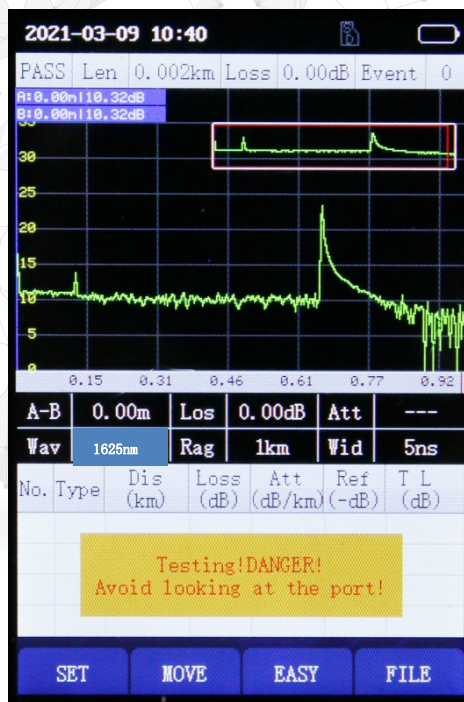
4.3.2 View event list

After selecting the test mode and parameters, press the [Test] key to enter the corresponding test interface. At the end of the test, the user can read the detailed parameters and event information from the event list (the average test mode will automatically jump out of the event list after the test time, and press the [Test] key again to display the event list in the real-time test mode).

Above the OTDR chart, the three key information, total length of the fiber link, total loss and number of events (events excluding start points and ghosts) are displayed.


Meaning of each item in the event analysis list:

| No	Item	Description
1	Number	The number of the fiber event
2	Type	Type of fiber event (attenuation event, reflection event or end event, etc.) "S" is the start event, "F" is the attenuaton event or reflection event, "E" is the end event, and "G" is the ghost event.
3	Distance(km)	The distance from the event point to the starting point
4	Loss(dB)	Loss value of the event point (dB)
5	Attenuation(dB/km)	The ratio of loss value (dB) to distance (km) from the event point to the last event point
6	Reflection(dB)	The return loss value of the event point
7	Total loss(dB)	The cumulative loss from the event point to the starting point

4.3.3 Cursor movement

Using cursor to measure point-to-point segment information

Step1, Press【F2】button to activate the cursor movement operation function
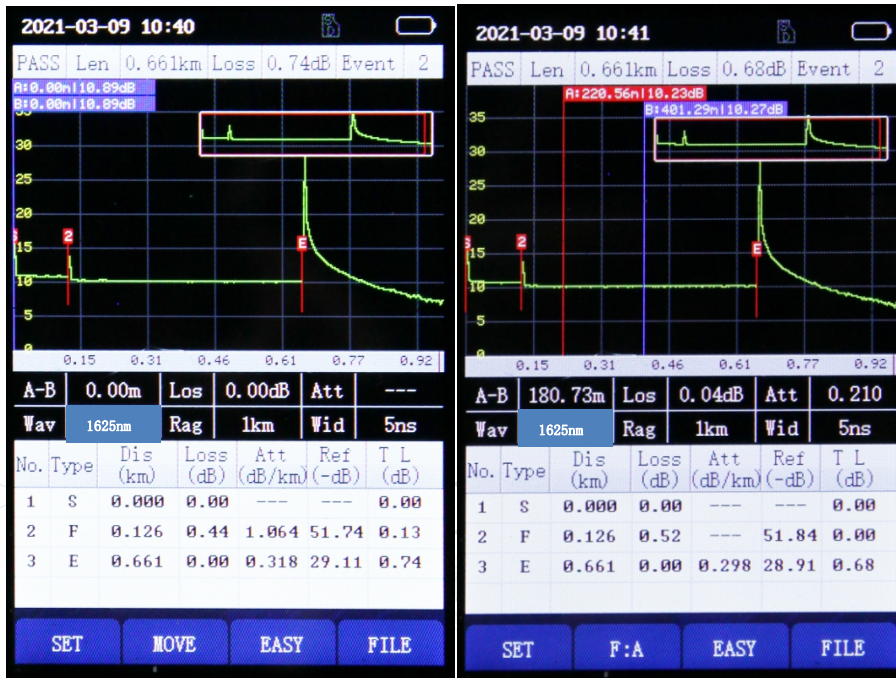
Step 2, The "Focus: A" and "Focus B" are displayed, indicating that the cursor A and cursor B can be moved to operate the keyboard 【◄ 】 【► 】 key left and right to move. When you move cursor A or B, cursor A will always remain to the left of cursor B.

Step 3, Move the cursor A or B to any point, and the screen will display the coordinate information of cursor A, the coordinate information of cursor B, and the segment information of optical fiber between A and B, including the optical fiber distance, optical fiber loss and optical fiber slope between A and B. The display is as following:
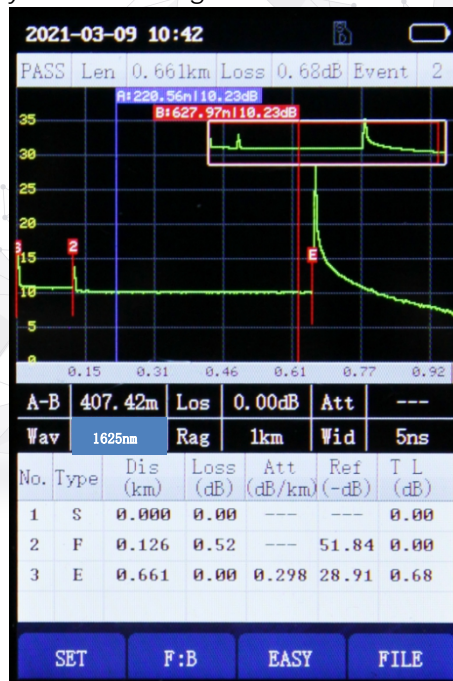
Step 4, Set the [F2] function key to Focus: A or Focus: B. at this time, operate the keyboard 【▲】 and 【▼】 to switch the cursor A / B back and forth on each event point of the curve.

4.3.4 Amplification and smaller of curve

Amplifying the test curve is beneficial to better observe the characteristics of optical fiber events

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Step 1, in the test interface, press the "enlarge" button to enter the curve amplification mode. At this time, a small red window will appear around the screen. At this time, the function corresponding to the [F2] key is switched to "Zoom".
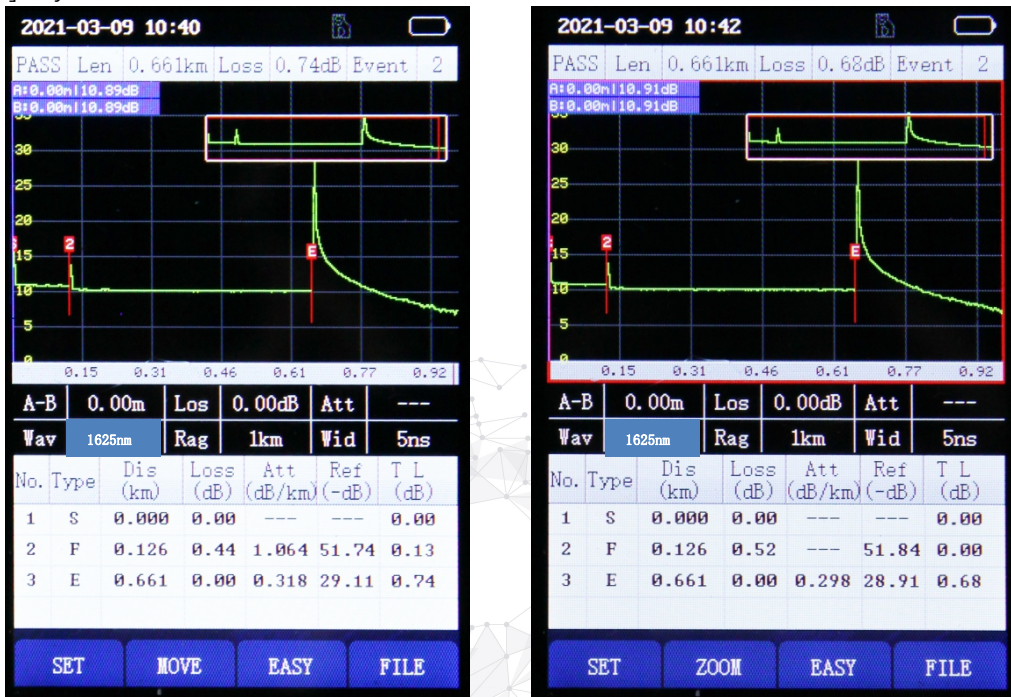
Step 2, Operate the keyboard 【 ▶ 】 It can enlarge the curve and operate the keyboard 【 ◀ 】 The curve can be smaller.
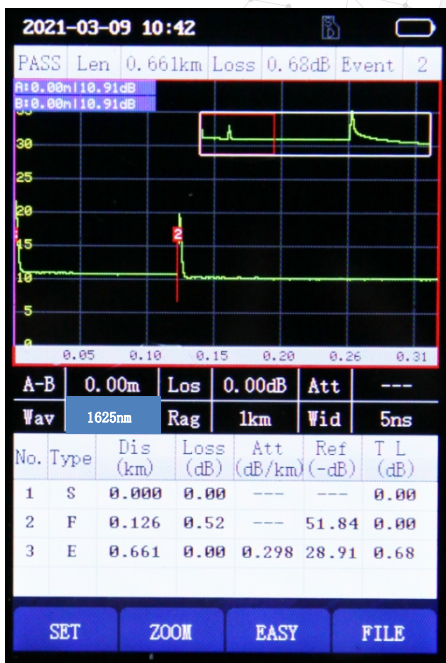
Step 3, Click [F2] again, and "zoom A" will be displayed at this time, indicating that the zoom operation will be zoomed with cursor A as the center position. If the function corresponding to the [F2] key is "zoom B", it means that the zoom operation of the test will be zoomed with cursor B as the center position.
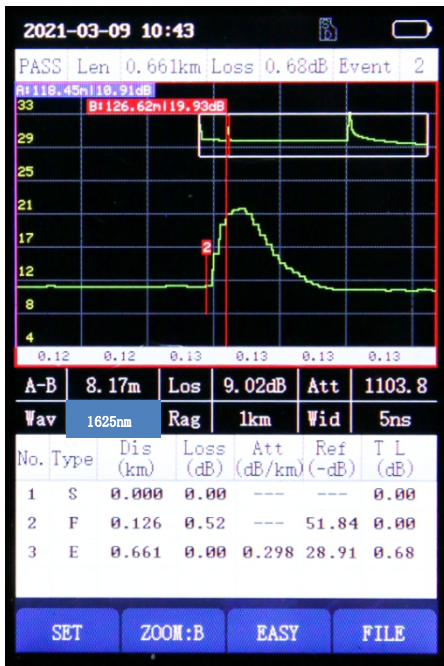
Step 4, click the [OK] button, and the test curve will be restored 1:1.

4.4 Simple mode

The Simple mode in FHO1500 can simplify the complex OTDR curve and make the test results easy to understand.

Click the [F3] button in the OTDR curve interface to enter the simple mode, and then click [F3] to return to the OTDR chart interface. At the top of the simple mode, three key information will be displayed: the total length of the optical fiber link, the total loss and the number of events (the number of events does not include the starting point and ghost).

3.5 File operation

3.5.1 Save test files

In the OTDR system setting interface, the automatic saving function of OTDR can be started.
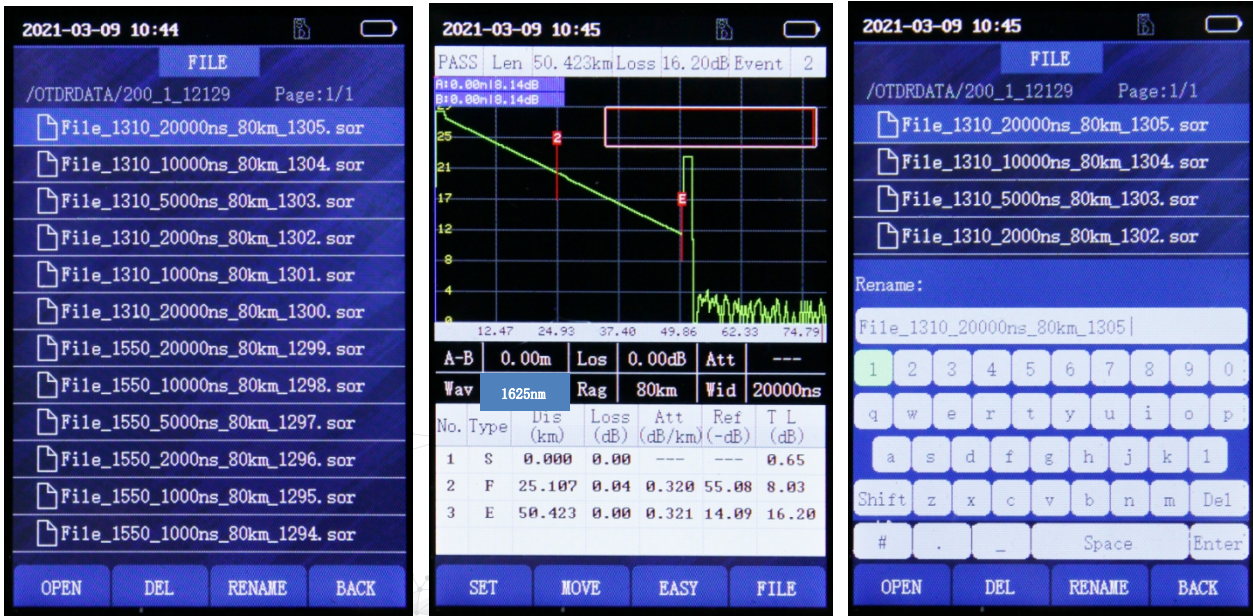
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Click the [F4] button to enter the file menu, and the test file will be automatically saved in the folder in the file menu.

3.5.2 Read/Delete/Rename test curve

Open the test folder, select the test file to be opened by clicking 【▲】 【▼】 and click [F1] to open the test curve. Click [F2] to delete the test curve. Click [F3] to rename the test curve.

5 Visual fault locator module

The FHO1500 is equipped with a 10mw VFL module (650nm) for fiber finder and find close fiber breakpoints.

VFL port

VFL turn off screen   VFL turn on screen

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The VFL has two emission modes

● CW mode，under this mode, FHO1500 will emit continuous visible light.

● Flash mode，under this option, FHO1500 will emit visible light flashing at the frequency of 1Hz/2Hz.

Press【CLOSE】【ESC】button to turn off the VFL or exit the VFL function.

Warning: when using the VFL module, do not aim the VFL port at the human eye, otherwise it may cause irreversible damage to the eye!

6   Stable laser source module

The FHO1500 is equipped with a stable laser source (output power>-13dBm) for measuring fiber loss with an optical power meter. The output wavelength can be switched between 1310nm and 1550nm.

| LS OFF | LS ON(CW mode) | LS ON(270Hz mode) |

OPEN： Turn on the stable laser source function

CLOSE： Turn off the stable laser source function

**WL：** Single wavelength 1625nm

MODE： Switching modulation frequency output mode between 270Hz/1kHz/2kHz.

Back: Exit the laser source module and return to the main menu.

Warning: when using the stable laser source module, do not aim the laser port at the human eye, otherwise it may cause irreversible damage to the eye!

7 Optical power meter module

FHO1500 is equipped with a normal optical power meter module for detecting the power of optical fiber signal and measuring the fiber loss with the laser source.

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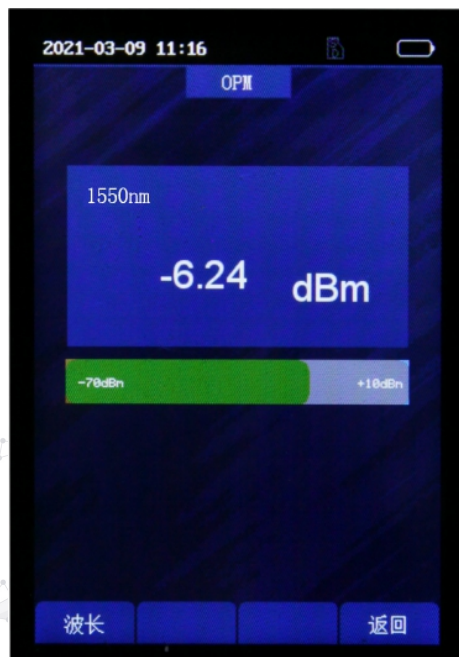
Wavelength switch: Short press F1 button to switch the measurement wavelength between 850/ 1300/1310/1490/1550/1577/1625/1650nm. In addition to the ordinary optical power meter, it also supports the measurement of downstream 1490nm and 1577nm wavelength in 10G PON network.
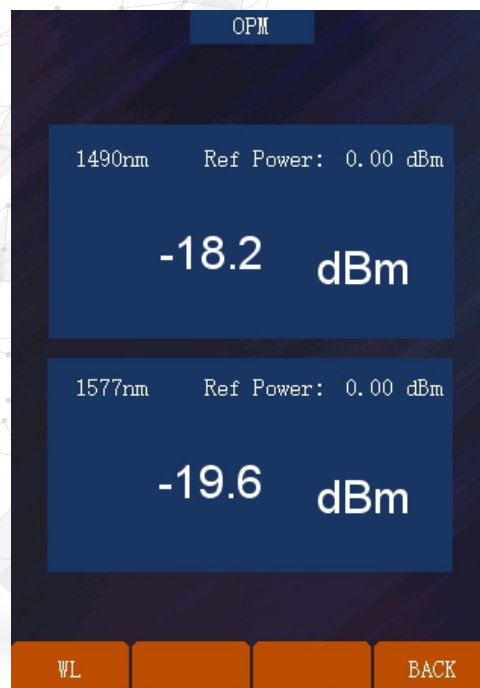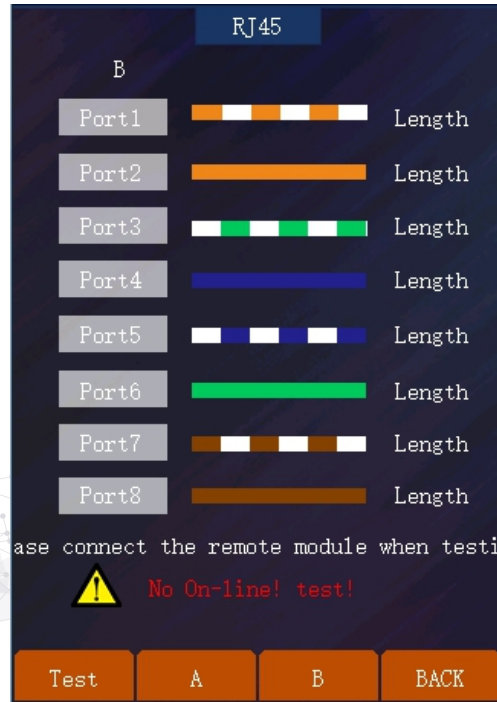

8 RJ45 cable test module

FHO1500 is equipped with RJ45 cable test port and remote module for RJ45 cable line sequence measurement based on TIA-568A and TIA-568B standards.

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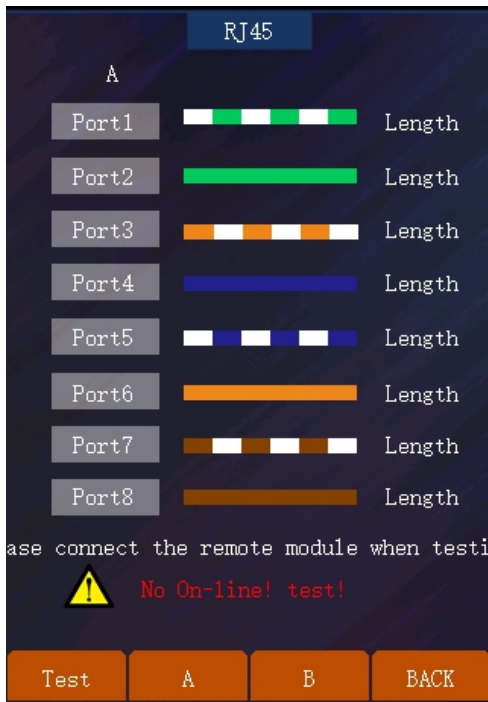
TIA-568A standard   TIA-568B standard

9 System information

Click the "Setup" menu in FHO1500 main menu interface to enter the system information interface, and the following basic settings can be made for the machine.

Automatic shutdown function: OFF/ 5 minutes / 10 minutes / 30 minutes
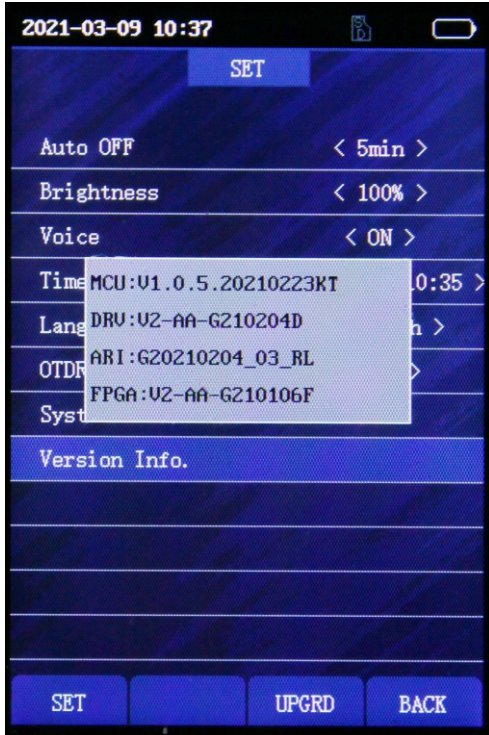Brightness selection: Dark light/25% brightness /50% brightness /75% brightness /100% brightness
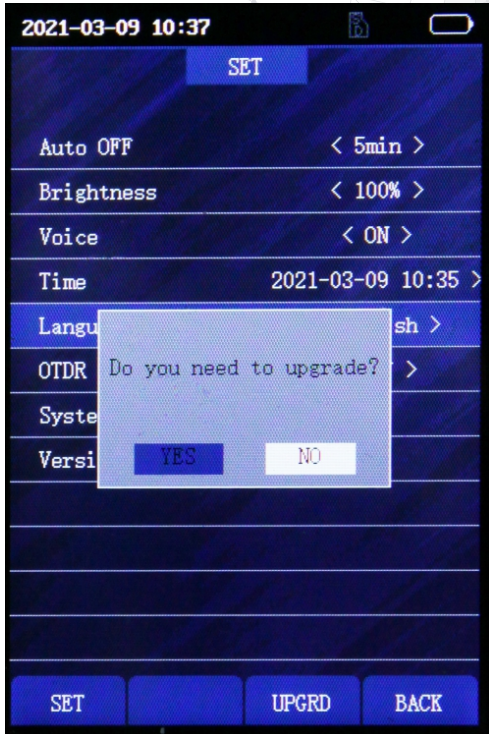Sound: OFF / ON
Date time setting
Language: Chinese / English
OTDR auto save: ON/ OFF

System reset: restore factory settings
Software system information

Upgrade：Download the upgrade firmware to the OTDR SD card，Click F3 button to upgrade (Please connect the power when upgrading)

10 Maintenance

Battery

FHO1500 Last Mile Explorer 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 .

Clean optical port

The optical connector of the instrument must be kept clean. The optical connector needs to be cleaned with special alcohol regularly. After the instrument is used up, please cover the dust cap. At the same time, the dust cap must be kept clean

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.

Clean tools

- ➤ Optical fiber cleaner (for cleaning optical connector)
- ➤ Optical fiber cleaning stick (for cleaning optical interface)
- ➤ Optical fiber cleaning cloth (for cleaning optical connector)
- ➤ Ethanol
- ➤ Cotton ball
- ➤ Soft tissue
- ➤ Clean pipe brush

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

Structure of optical port

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

Diagnosis

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.
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.
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.
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.

11 Contact us

Please contact the nearest agent or the following organization for related products:

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