
USER MANUAL

OPTICAL TIME DOMAIN REFLECTOMETER



RECORD OF CHANGES

[illegible]

SAFETY WARNING

**The voltages employed in this Equipment are
NOT high to endanger human life.**

**POWER
MUST BE SWITCHED OFF
before servicing the equipment
&
GREAT CARE
taken when making internal adjustments etc.**

**FOR FIRST AID IN CASE OF
ELECTRIC SHOCK SEE OVERLEAF**

FIRST AID IN CASE OF ELECTRIC SHOCK

FIG. 1.



FIG. 2.



FIG. 3.



1.	SWITCH OFF. If this is not possible, PROTECT YOURSELF with dry insulating material and pull the victim clear of the conductor. DO NOT TOUCH THE VICTIM WITH YOUR BARE HANDS until he is clear of the conductor, but DO NOT WASTE TIME.
2.	(a) Place the victim in the supine position. (b) Keep the air passages clear by turning the head to one side, opening the patient's mouth and clearing it of water, saline, mucus or blood, a lot of which might have accumulated in the back of the throat. (Figure 1)
3.	If the jaw is rigid try to force the mouth open by pressure on the gum behind the last molar tooth of the lower jaw. When the upper air passages are thus cleared, tilt the head backward and force the jaw forwards from the angles of the jaw in front of the ears. This would prevent mechanical obstructions to the upper air passages. (Figure 2-3)
4.	(a) Then hold the chin up and forward with one hand and pinch the nostrils of the victim with the other. (Figure 4) (b) Take a very deep breath and apply your mouth to that of the victim and blow into his mouth, until the chest of the victim moves up indicating filling of the lungs. (NEVER ALLOW THE CHIN TO SAG). (Figure 4)

FIG. 4.



- | | |
|----|---|
| 5. | When the chest has moved up, withdraw your mouth and allow the chest to sink back. REPEAT this process every three to four seconds until the victim begins to breathe again or until he is taken over by a medical attendant. This method can be continued in an ambulance during transit of the patient from the site of accident to the nearest medical centre. |
|----|---|

HAVE SOMEONE ELSE AND SEND FOR A DOCTOR.

KEEP PATIENT WARM AND LOOSEN HIS CLOTHING.

DO NOT GIVE LIQUIDS UNTIL THE PATIENT IS CONSCIOUS.

WARNING

DO NOT REMOVE OPEN THE EQUIPMENT SINCE THERE ARE SENSITIVE COMPONENTS INSIDE.

WARRANTY WILL BE VOID INCASE OF DETECTION / ATTEMPT OF REPAIR BY UNAUTHORISED PERSONNEL.

This user's manual explains the features, operating procedures, and handling precautions of the 1131. To ensure correct use, please read this manual thoroughly before beginning operation. Keep this manual in a safe place for quick reference in the event that a question arises.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the software's performance and functionality. 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 ANDIG SYSTEMS ON 080-23378976.
- Copying or reproducing all or any part of the contents of this manual without the permission of ANDIG SYSTEMS is strictly prohibited.

Trademarks

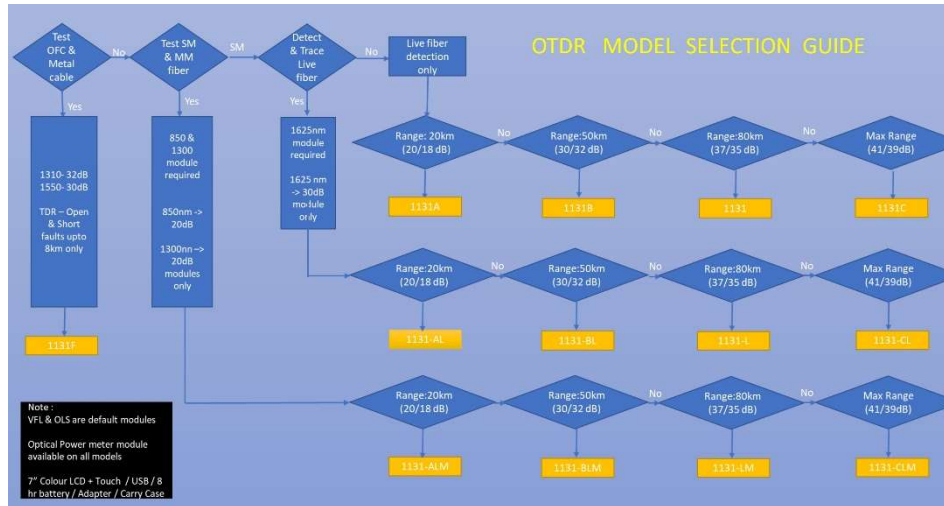
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ANDIG is a registered trademark & using it without written consent will attract penalty.

Signalysr software is a proprietary software developed of ANDIG SYSTEMS.

Congratulations on being a proud holder of INDIA's 1st & Fully Indigenous OTDR. We are very proud of our efforts but will always look at user feedback to better it. Kindly do send your feedback to andigsystem@gmail.com

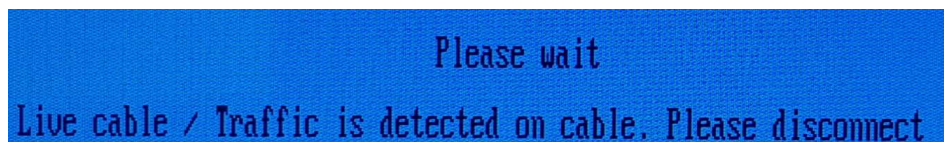
MODEL SELECTION GUIDE



Please be aware of any APC connector used in the network. APC connectors are mainly used in long haul & do not produce any reflections that are seen on the OTDR Screen. APC Connectors are designed to deflect the Fresnel by 7° causing it to look as a non-reflective splice.

WARNINGS & CAUTIONS

In case the OTDR not having 1625nm laser is connected to a live fiber, ie fiber with traffic, the following warning is shown to the user to avoid damage to the equipment.



NOTE:-

IF YOU HAVE PURCHASED AN ANDIG OTDR EQUIPPED WITH 1625nm LASER (model number ending with L) & IF YOU ARE SCANNING THE FIBER USING 1625nm LASER WHICH IS SPECIFICALLY USED FOR LIVE FIBER DETECTION , OTDR WILL NOT SHOW THE " LIVE FIBER WARNING".

CAUTION!

- To avoid serious eye injury, never look directly into the optical outputs of fiber optic network equipment, test equipment, patch cords, or test jumpers.
- The input ports of TDR should not be connected to a live cable / cable with voltage more than 60V as this could damage internal systems.
- Battery will discharge as the temperature reduces & drops below 0° Celsius. Lower the temperature, lower the back up. Please note that this is not a defect but the physical limitation of a Lithium Ion battery pack.

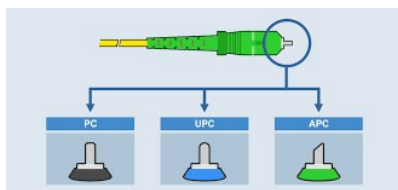
WARNING !

Match the PATCH CORDS used with the output of OTDR. OTDR output will be as per order - either APC or UPC. **Default output type of OTDR is UPC.**

ALWAYS CONNECT **APC to APC** & **UPC to UPC**. DO NOT INTERCONNECT. WRONG CONNECTORS CAUSES LOSSES OF ~4dB & IMPROPER LOSS CALCULATION WHICH LEADS TO ERRONEOUS WAVEFORM ANALYSIS.

APC – Generally adopted colour is **GREEN** (as shown in photo below)

UPC – Generally adopted colour is **BLUE** (as shown in photo below)



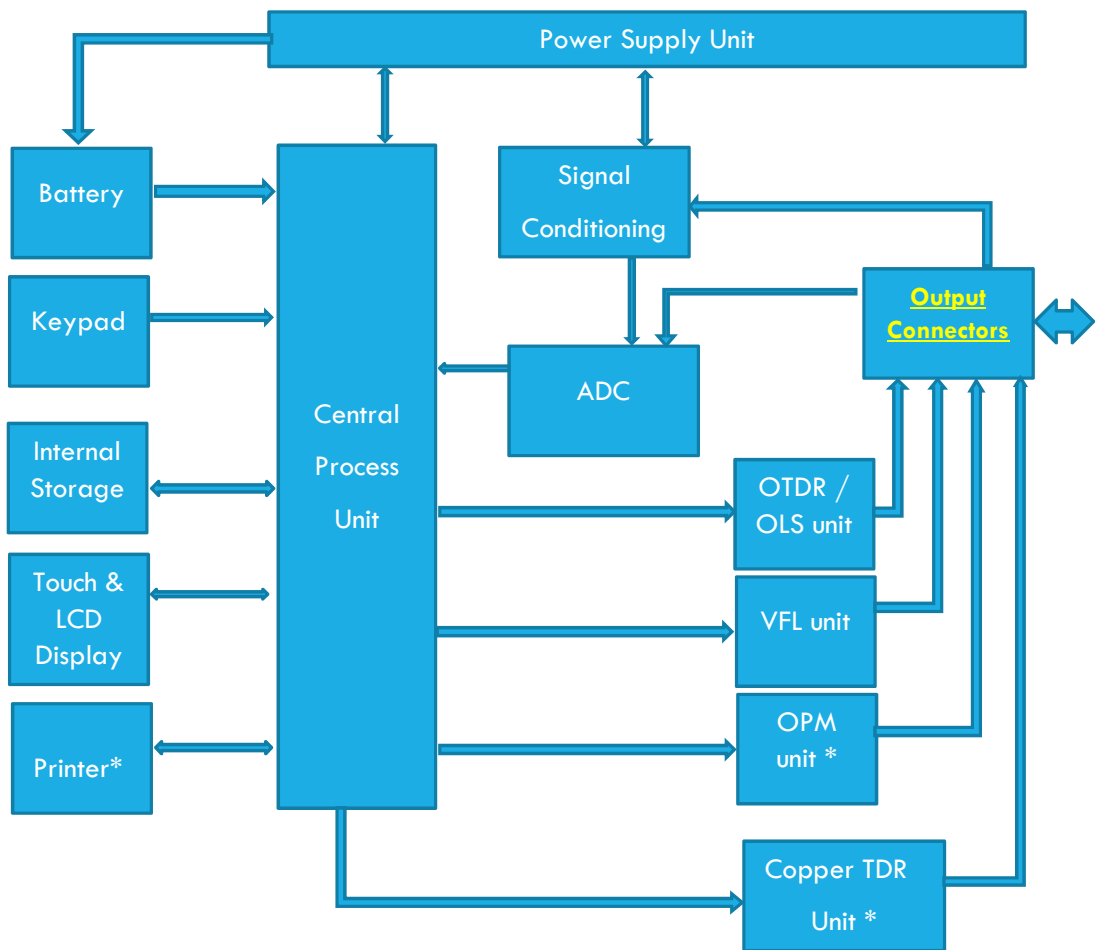
WARNING !

- Always use ADAPTER supplied by ANDIG SYSTEMS , incase of damage , loss or damage to internal wiring contact us for repair / replacement.
- Do not plug the unit into a power outlet that is shared by other devices.
- Never modify the power cord or excessively bend, twist, or pull it.
- Do not allow the power cord to become damaged. Do not place heavy objects on the power cord or expose it to heat.
- Never touch the AC adapter while your hands are wet.

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System Configuration :



“ * ” - indicates functionality depending upon model & option chosen

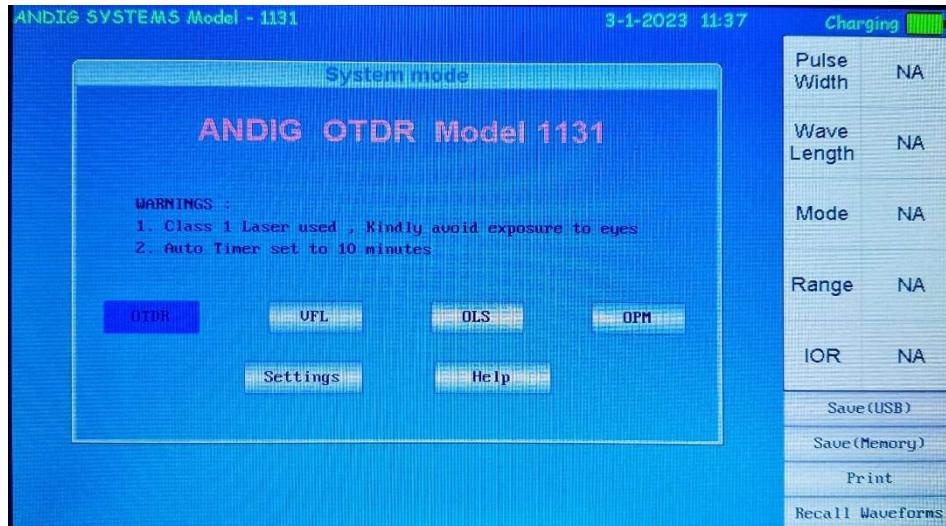
The Model 1131 OTDR can test for breaks, connections, losses, and the like. In addition, by opting for additional modules, you can use the equipment as an optical power meter & Copper Cable TDR . The optical light source & visible light source are standard features.

The OTDR runs on an AC adapter & on internal battery. The AC adapter is required to charge the internal battery.

We recommend that you charge the battery when battery is below 40% .

OTDR Introduction :

The OTDR allows you to characterize a fiber-optic span, usually optical fiber sections joined by splices and connectors. The optical time domain reflectometer (OTDR) provides an inside view of the fiber, and can calculate fiber length, attenuation, breaks, total return loss as well as splice, connector and total losses.



Connector image (FIG C)

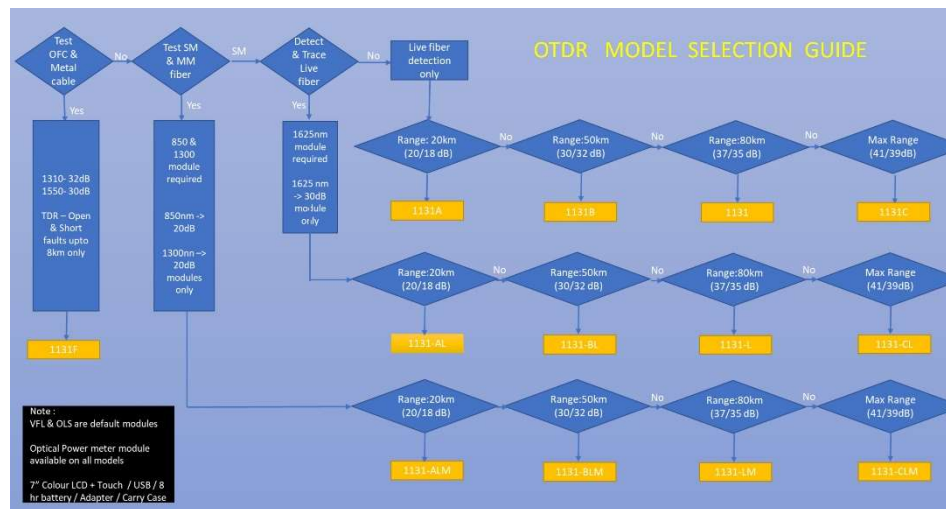


OTDR Model Selection Guide:

The modules in the system in your possession depends upon the purchase specifications. The modules & add-ons are what define the final cost. ANDIG SYSTEMS ® is an Indian manufacturer of test equipments & the OTDR showcased is fully indigenous with the software & hardware entirely developed inhouse. There

are customisation options which the purchaser can avail. The user model selection guide below is to help the user understand the various models & their applications.

FLOW PATH TO SELECT THE REQUIRED MODEL :



The standard features of the OTDR include

1. 7inch TFT Colour 800 x 480 Capacitive Touch screen.
2. Optical Light Source
3. Visual Fault Locator
4. Lithium Ion Battery (Customisable : 6500mAh ~ 10,000mAh)
5. Silicone Protective Case
6. Plastic Carry Case

OTDR Model Selection Guide:-

SM stands for single mode wherein only 1310nm , 1490nm & 1550nm signals are deployed. The advantage of SM fiber is that the losses per km are less & used for long haul application.

MM stands for Multi Mode wherein the wavelengths used are 850nm & 1300nm are used. As the name , MM fiber are used for short haul , LANs & WANs mainly since the losses in theses fiber are quite high.

The table below will give you a details on what the attenuation per km is & also losses in various connectors etc. This will help you build the loss chart or calculate the loss in network under standard testing conditions. Deviations from the calculated loss vs actual loss should lead you to analyse where the faults lie.

Wavelength/ Mode	Fiber Core Diameter	Attenuation per Kilometer*	Attenuation per Splice	Attenuation Per Connector
850 nm multi-mode	50 µm	2.40 dB	0.1 dB	0.75 dB
850 nm multi-mode	62.5/125 µm	3.00 dB	0.1 dB	0.75 dB
1300 nm multi-mode	50 µm	0.70 dB	0.1 dB	0.75 dB
1300 nm multi-mode	62.5/125 µm	0.75 dB	0.1 dB	0.75 dB
1310 nm single-mode	9 µm	0.35 dB	0.01 dB	0.75 dB
1550 nm single-mode	9 µm	0.22 dB	0.01 dB	0.75 dB

OTDR Basic Principles:

An OTDR sends short pulses of light into a fiber. Light scattering occurs in the fiber due to discontinuities such as connectors, splices, bends, and faults. The OTDR then detects and analyzes the backscattered signals. The signal strength is measured for specific intervals of time and is used to characterize events.

The OTDR calculates distances as follows:

$$\text{Distance} = (c/n) \times (t/2)$$

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

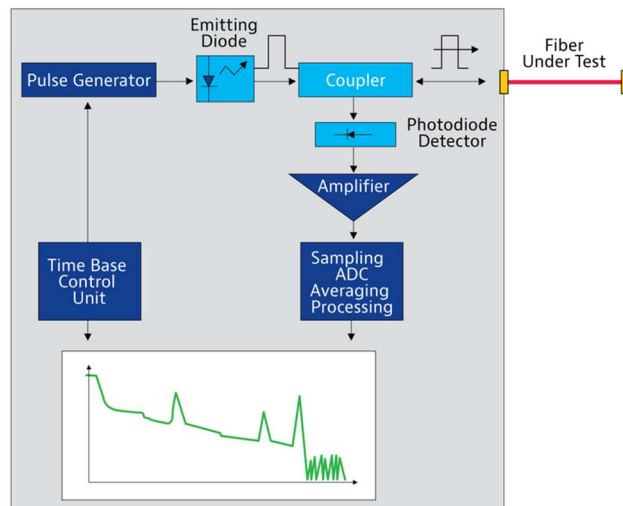
t = time delay from the launch of the pulse to the reception of the pulse

n = index of refraction of the fiber under test (as specified by the manufacturer)

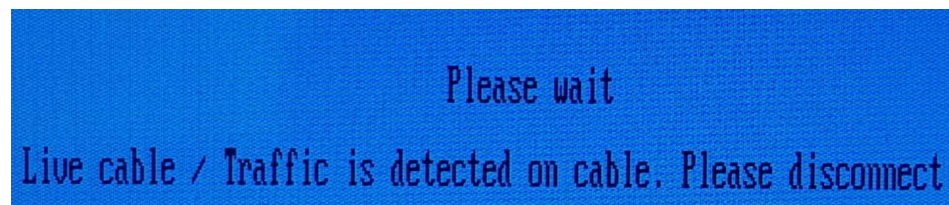
An OTDR uses the effects of Rayleigh scattering and Fresnel reflection to measure the fiber's condition, but the Fresnel reflection is tens of thousands of times greater in power level than the backscatter. TM Rayleigh scattering occurs when a pulse travels down the fiber and small variations in the material, such as variations and discontinuities in the index of refraction, cause light to be scattered in all directions. However, the phenomenon of small amounts of light being reflected directly back toward the transmitter is called backscattering. TM Fresnel reflections occur when the light traveling down the fiber encounters abrupt changes in material density that may occur at connections or breaks where an air gap exists. A very large quantity of light is reflected, as compared with the Rayleigh scattering. The

strength of the reflection depends on the degree of change in the index of refraction.

The backscatter and reflected light that occur in the optical fiber cable under measurement returns to the OTDR port. The returned measurement light is received by the light detector (APD: Avalanche photodiode), read as a digital signal by the A/D section, subjected to averaging and other waveform processing, and output to the processor where the OTDR waveform is displayed.



When there is live traffic, the wavelength to be used is 1625nm / 1650nm which does not cause interference with traffic. Using a regular OTDR, ie not equipped with 1625nm Laser will result in no waveform being displayed. ANDIG OTDR checks the presence of live fiber in all regular OTDR & generates a warning in case of live fiber. Please note, trace or analysis cannot be performed using the 1310 & 1550 lasers.

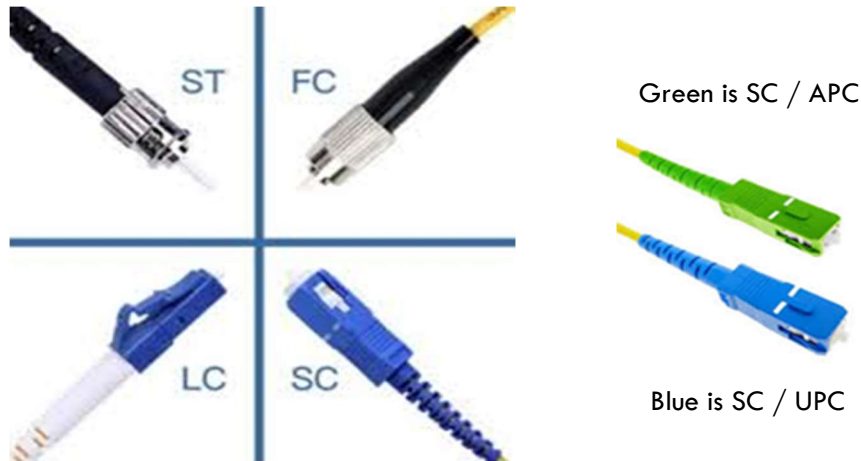


For Detecting & Tracing fibers with live signals, you can use the ANDIG - Model 1131AL / 1131BL / 1131 L or 1131 CL depending upon the dynamic range required.

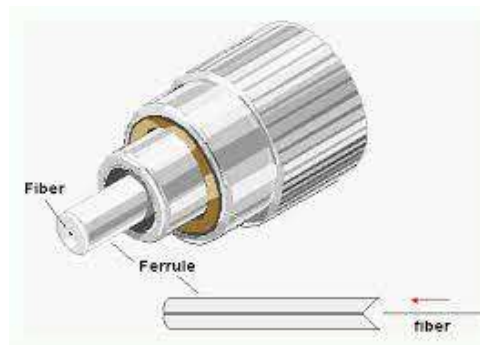
BASIC SET UP OF ANDIG OTDR for Tracing :

TYPES OF CONNECTORS & FERRULES:

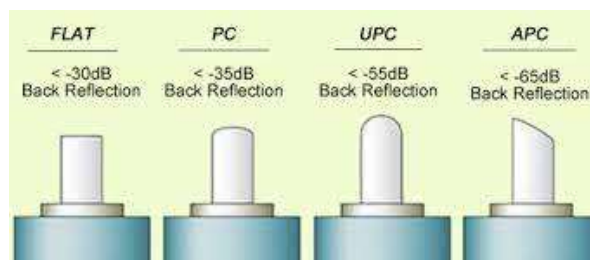
The tip of the patch cords where the ferrule is visible is the most important & most often the part that is neglected or not given its due importance. Proper care if taken avoids errors. There are multiple types of connectors , as shown below



Please note the above are types of connectors only. The ferrule as shown in the figure below are also available in different types.



These various types of ferrule shapes are mentioned with their names



The output connector of the OTDR can be customised to suit your purpose. The output connector can be APC or UPC.

Please note that in case of an APC connector ,the initial spike of initial reflection may not appear or be very minimal on the screen.

Always match the type of patch cord with the output connector of the OTDR, ie Connect an APC patch cord to the output port if output port of OTDR is APC or Connect an UPC patch cord when the output port of OTDR is UPC type. Mismatch of connectors cause significant losses (up to 4 db or more). This further results in erroneous readings & wrong analysis by the equipment.

ANDIG SYSTEMS is not responsible for damage or errors caused by bad fiber cleaning or handling. Ensure that your patch cord has appropriate connectors. Joining mismatched connectors will damage the ferrules and may cause errors.

STEPS TO CORRECTLY CONNECT PATCH CORD TO OTDR:

1.Clean the fiber ends as follows:

- Gently wipe the fiber end with a lint-free swab dipped in isopropyl alcohol
- Use compressed air to dry completely
- Visually inspect the fiber end to ensure its cleanliness.

- OR -

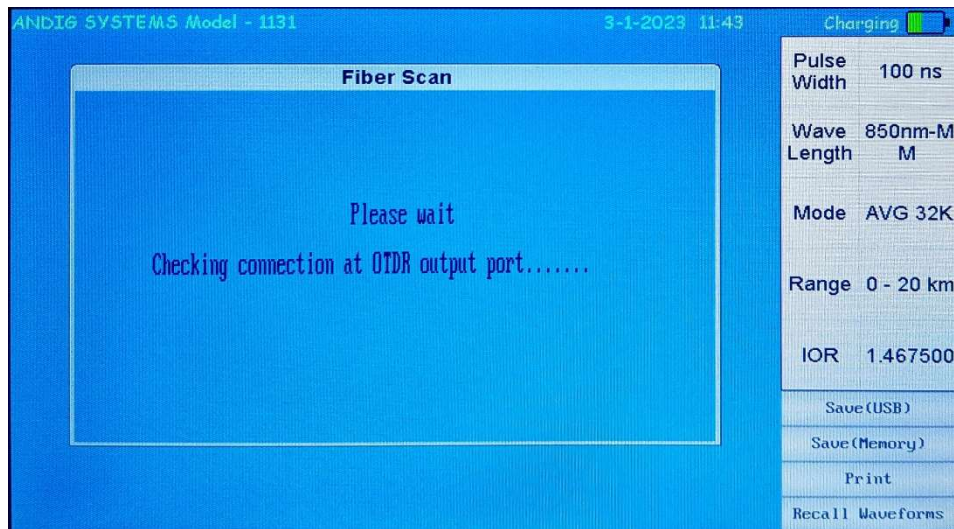
Always carry a Cleaning Pen as shown below, and use it every 5~10 mating.



2. Carefully align the connector and port to prevent the fiber end from touching the outside of the port or rubbing against other surfaces.

3. Push the connector in so that the fiber-optic cable is firmly in place, thus ensuring adequate contact.

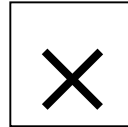
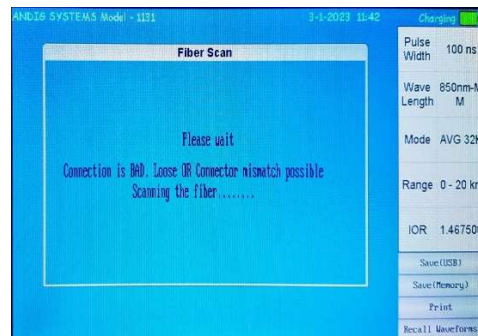
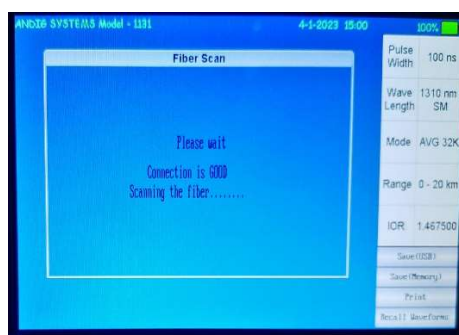
OUTPUT CONNECTION CHECK by ANDIG OTDR:



ANDIG OTDR performs a connection check during every scan of the trace & gives a **GOOD , AVERAGE or BAD / LOOSE CONNECTION** indication to the user.

In case of equipment gives a BAD / LOOSE connection indication, the displayed waveform **will** not be accurate. Please clean the connector & trace again.

The connection should show a GOOD or AVERAGE indication for proper analysis.



SETTING OF PARAMETER THRESHOLD FOR EVENTS:

ANDIG OTDR gives you complete flexibility to control the type of events you wish the equipment to capture. There are 2 main event level settings

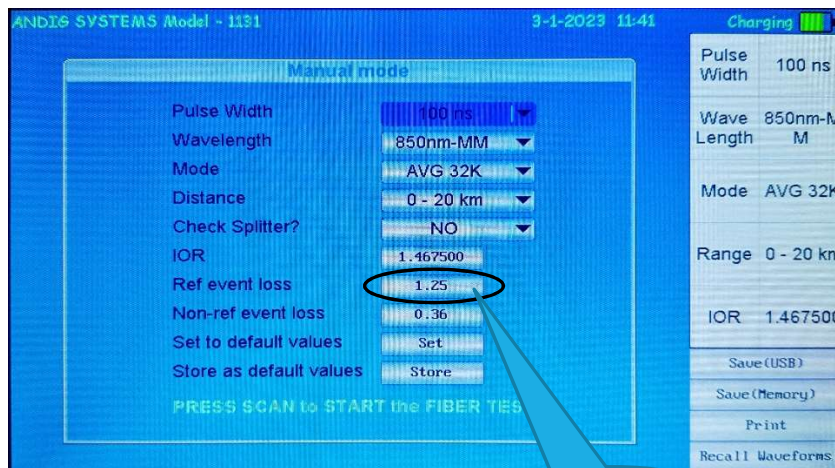
1. Ref . Event Loss
2. Non-ref event Loss

Ref. Event Loss :-

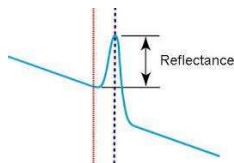
These are the reflective events seen in the trace & are caused by Fresnel reflection which is caused due to air- glass interfaces usually found in connectors or at the end of fiber.

There are preloaded default values which change as per the pulse width & distance set. Lowering the value will cause smaller reflections to be also captured. The reflective event loss value can be set from 0.01dB to 2.00dB.

The values of the parameter is incremented by pressing OK button continuously or by using the touch interface. Values are incremented in steps of 0.05dB.



Reflective Event

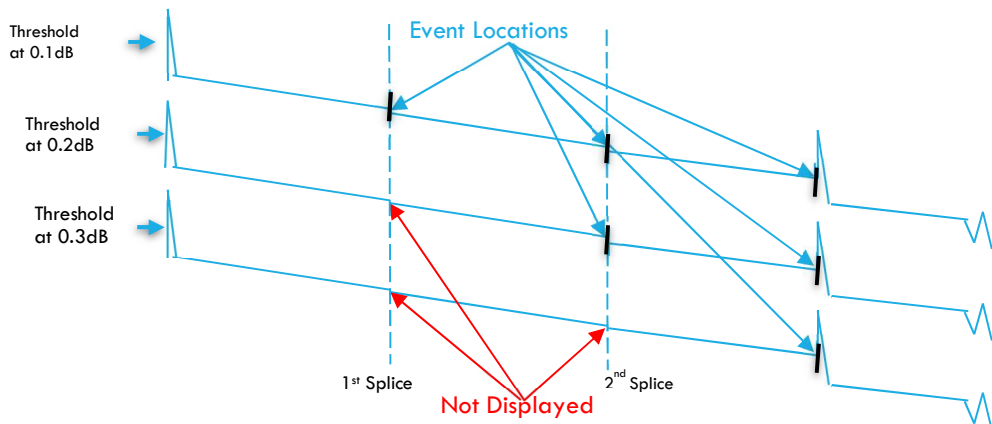
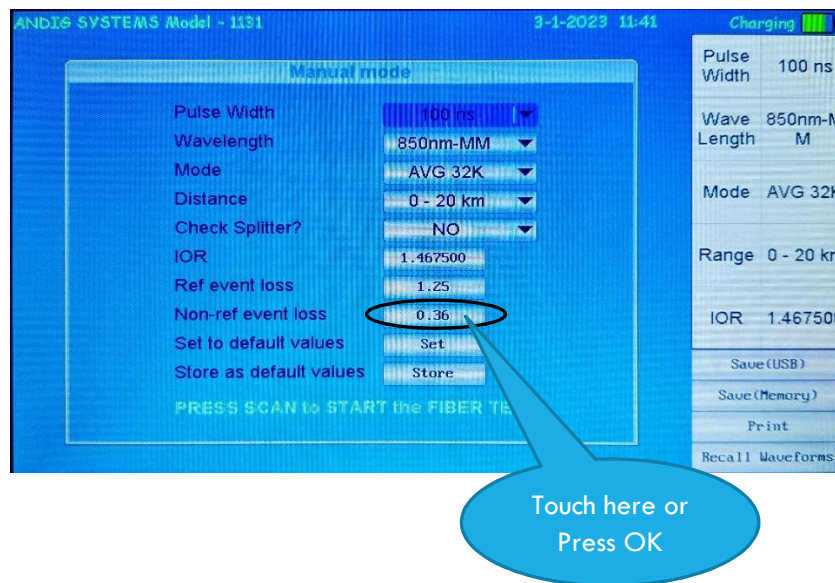


Non-ref Event Loss:-

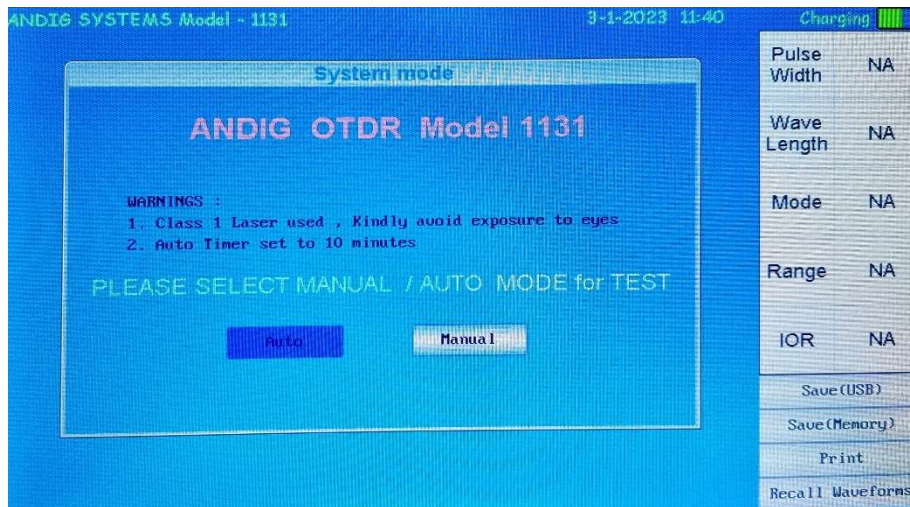
These are the splice losses that occur due to improper splicing of 2 fiber. The splice loss to be captured by the OTDR can be set in steps of 0.01 & can be set from 0.01dB to 1.00dB. Effects of varying threshold are shown in figure below.

The values of the parameter is incremented by pressing OK button continuously or by using the touch interface. Values are incremented in steps of 0.01 dB.

Lower values of Non-ref event loss lowers the threshold for marking a particular loss as an event. The default values are already pre-loaded & kept at 0.25dB or above. Incase user wants to view smaller loss events also, then the value should be lowered to achieve the desired events.



FIBER SCAN :-



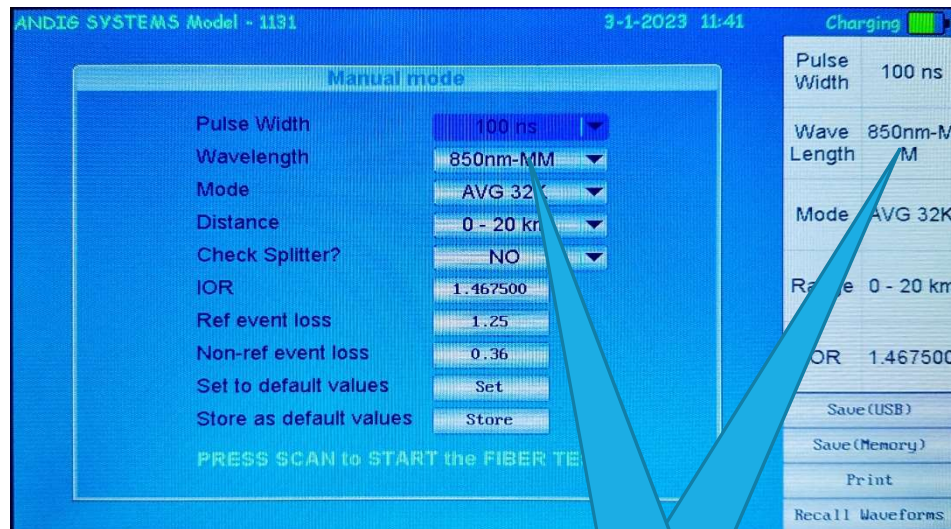
The ANDIG OTDR module upon being turned on gives the user the option to choose between the AUTO & MANUAL operation. The AUTO scan mode is a one step / one click procedure where the user will simply select the AUTO option & press the SCAN button.

The OTDR in an AUTO mode will hunt for the end of fiber in the connected fiber. It sends pulses & searches for the last Fresnel reflection which indicate the fiber ending at a specific location. The AUTO function provides a good account of what the fiber length is connected. However, it may be advisable to use the manual mode to confirm the fiber length.

The details of the trace are populated in the table below the OTDR waveform. The user can scroll down the events using the touch interface (by swiping the tabular section from down to up).

Please note that the AUTO MODE may not be sufficient incase of a high loss event. When the network is characterised by a single high loss event that may be caused due to a Fiber Management Distribution System or a splitter of 1:16 or more, the loss in these events will cause the OTDR to assign the End of Fiber to such a high loss event, thereby stopping the further automatic increments in pulse widths & distance ranges. These high loss events although less probable limit the performance. During such unique situations, ANDIG suggests that the USER go on to the MANUAL MODE for such trace scans.

MANUAL MODE:-



Touch either areas
of screen to change

The following settings can be made in the manual mode –

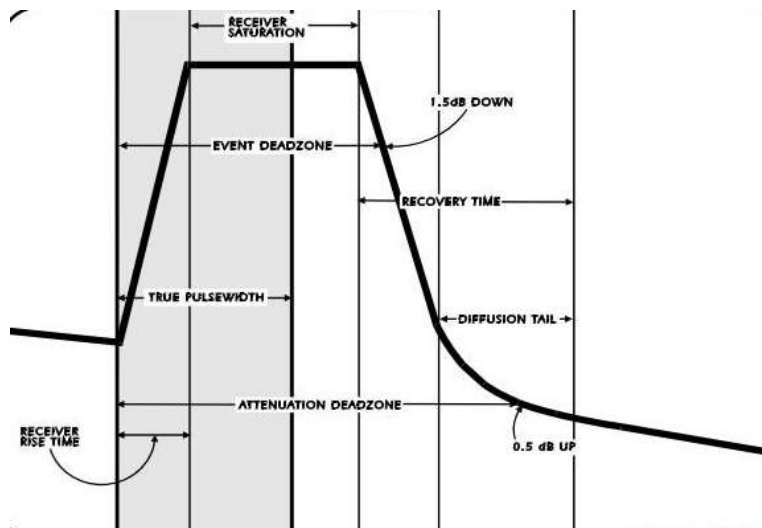
A longer pulse allows you to probe further along the fiber, but results in less resolution. A shorter pulse width provides higher resolution, but less distance range.

User may send pulses as per recommendation below:

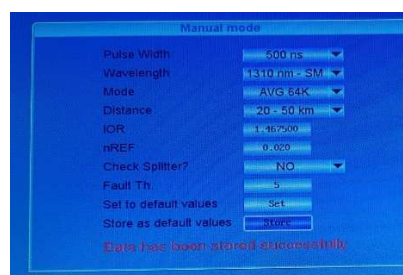
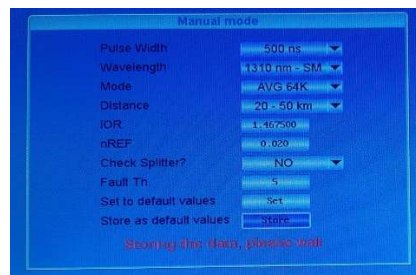
- 3ns /20 ns – Distances up to 5km
- 50ns /100ns – Distances up to 20km
- 500ns / 1 μ s - Distances up to 50km
- 10 μ s - Distances up to 100km
- 20 μ s - Distances greater than 100km

The use of higher pulse width is a dual edged sword. Although, the higher pulse width generated higher power, it also has a larger dead zone. Dead zones originate from reflective events (fusion splices, fibre optic connectors, pressure points, etc) along the link and can affect the OTDR's ability to accurately measure attenuation on shorter links and differentiate closely spaced events. The OTDR will become temporarily blinded by the first event it picks up and will not see upcoming events close to each other and will instead pick them up as one event. Dead zones can extend hundreds of metres from the OTDR unit but can be reduced (but never eliminated) by adjusting the pulse width in accordance with the length of the fibre.

DEAD ZONE IN A PULSE



The **MANUAL** mode has an added option of storing the last settings for fault analysis in its memory. Hence the user need not remember the settings every time. This is also a useful feature when the scans are done repeatedly for the same fiber but by different users thereby eliminating any need for duplication of work.



WAVE LENGTH:

The options the user may have on their OTDR are as follows:-

Single Mode Tests	Multi Mode Tests	Live Fiber Testing
1310 nm 1550 nm	850 nm 1300 nm	1625nm

The user can select any one of the wavelengths from the drop down list either using the up & down arrow keys or by a finger swipe along the scroll bar. During the

menu display, the wavelength, Pulse width, Mode & Range can be incremented using the touch screen by touching the specification displayed in the boxes on the right of the screen.

MODE / No of TIMES THE RESULT IS AVERAGED:

The user can select multiple modes using the drop down menu by highlighting the MODE options using the up & down arrow key and by pressing OK. Alternatively the user can also swipe with fingers on the screen or simply touch the Mode options on the right side of the screen. The options are

MODES OF OPERATION	
REALTIME – Trace refreshes constantly	Averaging No of Averaging – 8K / 16K / 32K / 64K / 128K / 256K / 512K

The higher averaging results in higher process time but also generates higher accuracy of the result. The default averaging mode is 32K which has been empirically found to be the best combination based wherein the results are quick & also accurate.

The approximate time taken for each mode is mentioned below for the user

	Aver 8K	Aver 16K	Aver 32K	Aver 64K	Aver 128K
1km	15 sec	18 sec	18 sec	20 sec	22sec
2km	16 sec	19 sec	20 sec	22 sec	25 sec
5km	16 sec	19 sec	20 sec	25 sec	30 sec
10km	17 sec	20 sec	25 sec	30 sec	45sec
20km	19 sec	22 sec	30 sec	45 sec	70 sec
50km	45 sec	55 sec	70 sec	100 sec	170 sec

DISTANCE :

The OTDR offers various lengths that can be tested.

The Range for testing the fiber starts 0 ~ 1km, increases to 0 ~ 2km, 0 ~ 5km, 0 ~ 10km, 0 ~ 20km and goes up to > 200km. The distance determines the amount of time taken by the OTDR to display results on the screen. The distance setting in conjunction with the averaging setting are the 2 deciding factors that decide time needed for analysis & the approximate times are shown in above table. Please note, the analysis times mentioned above are specific to ANDIG OTDR only.

SPLITTER CHECK :

The data from the waveform is checked for various losses & if the option is marked “ YES” (default being “NO”) , then the standard losses in different types of splitters are cross referenced with the actual losses in the events & splitters are marked as a 1:2 / 1:4 / 1:8 / 1:16 /1:32 / 1:64 splitter as the case may be. This feature is effective when the dynamic range of the OTDR is greater than 38dB. The need to inject a higher power pulse with a lower pulse width to reduce the dead zone is when this option becomes useful.

INDEX OF REFRACTION:

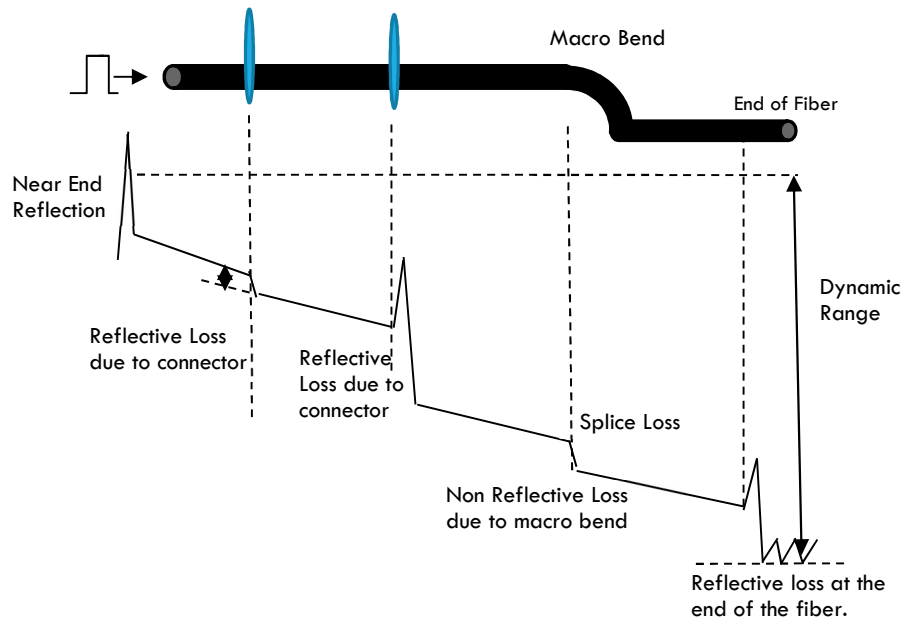
The index of refraction (IOR) value (also known as group index) is used to convert time-of-flight to distance. Having the proper IOR is crucial for all OTDR measurements associated with distance (event position, attenuation, section length, total length, etc.). IOR is provided by the cable or fiber manufacturer.

The OTDR has a default value stored based on the most commonly used fiber, namely the G-652D. The user can change the IOR at any time if the data from the fiber manufacturer is available. The value can be changed by either pressing OK or by using the touch interface which increments the IOR value in steps of 0.000005.

Use of incorrect IOR may result in incorrect loss distance.

Optical Pulse Waveform Display

The optical pulse applied to the optical fiber cable is reflected at different points of the optical fiber such as its connections, bent sections, and the open end of the fiber. These sections generate loss. The measured result is displayed as a waveform that has distance represented in the horizontal direction and loss level represented in the vertical direction. On the waveform, detected losses or



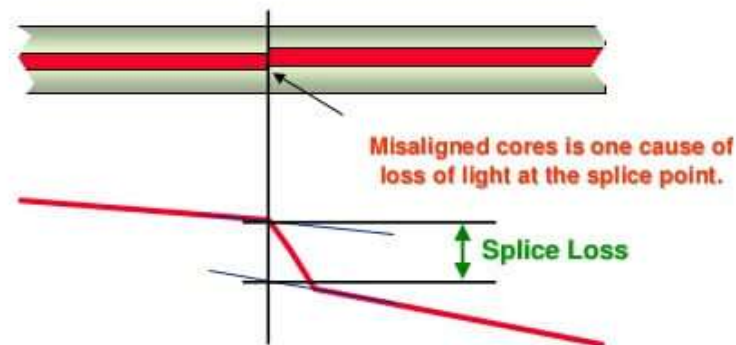
Near-end Reflection - This is the reflection that occurs at the point where the 1131 and the optical fiber cable are connected. This also includes the 1131's internal reflection. In the section where this near-end reflection is detected, even if there are other connections, the loss and reflections that occur at these points cannot be detected. This section is the near-end dead zone. When you are measuring a short distance, connect a launch fiber cable to reduce the effect of the near-end reflection.

When using an APC OTDR output connector, please note there will NO or MINIMAL NEAR END REFLECTION (INCIDENT PULSE) DUE TO THE NATURE OF THE APC CONNECTOR.

Backscatter : When light travels through an optical fiber cable, Rayleigh scattering caused by changes in the density of materials that are smaller than the light's wavelength and inconsistencies in the fiber's composition generates loss in the

optical fiber itself. The portion of the scattered light that travels in the direction opposite to the direction of propagation is known as backscatter.

Splice Loss : Because spliced sections of optical fiber cables have a great number of changes in the material's density and inconsistencies in the cable's composition, loss due to Rayleigh scattering becomes large, and splice loss occurs in these sections.

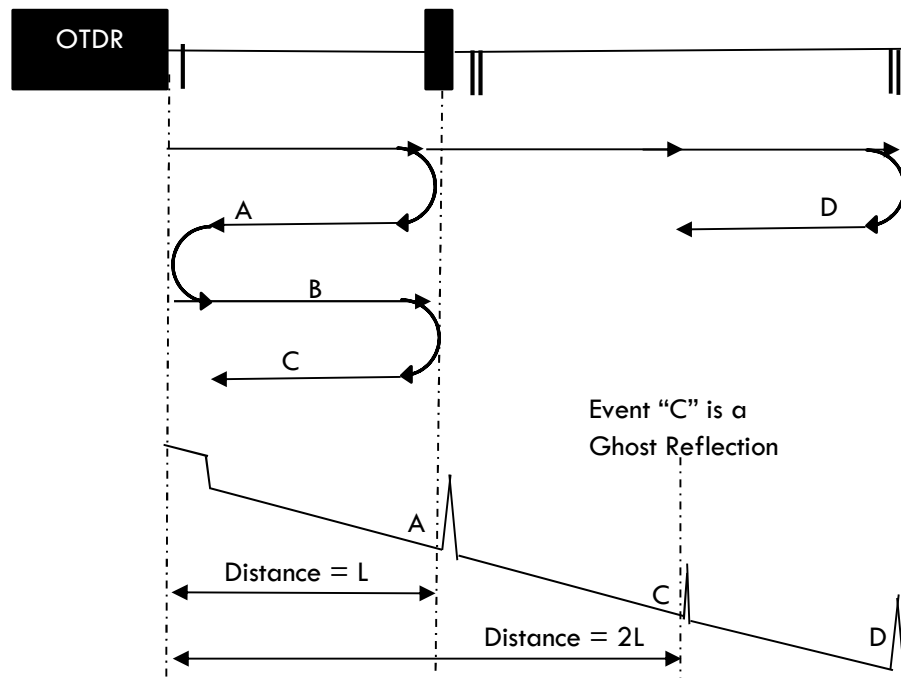


Reflection at the Connection Point of Connectors: Using a connector to connect two optical fibers is different from splicing them together in that a small gap remains between the two fibers. Because this gap has a different index of refraction, reflection occurs.

Ghost Reflections: Sometimes you will see a Fresnel reflection where you don't expect one—usually after the end of a fiber. This usually happens when a large reflection occurs in a short fiber. The reflected light actually bounces back and forth within the fiber, causing one or more false reflections to show up at multiple distances from the initial large (true) reflection. That is, if a large reflection occurs at 1,325 feet, and there is an unexpected reflection at 2,650 feet (twice the distance to the first) and another at 3,975 feet (three times the distance to the first), then it is likely the 2nd and 3rd reflections are "ghosts."

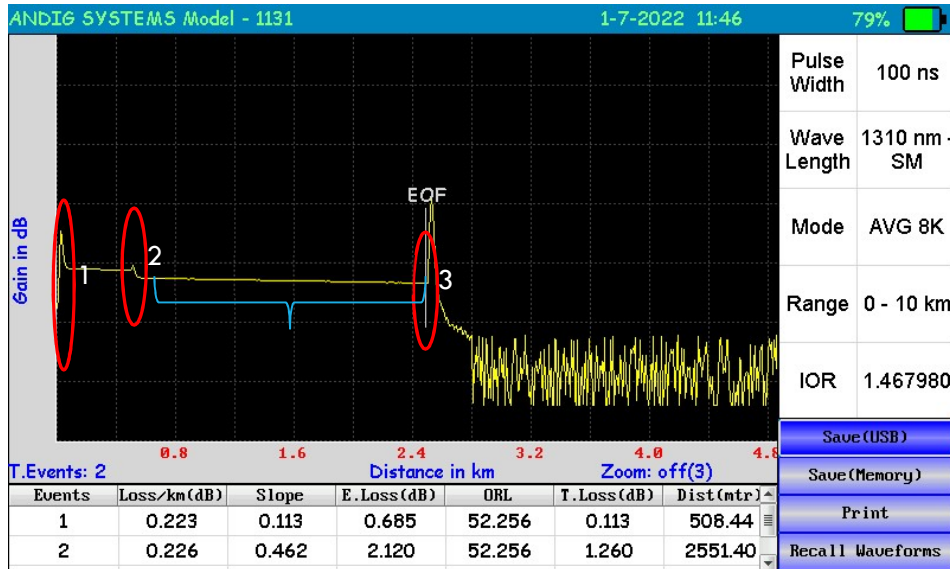
How Secondary Reflections Are Generated The optical pulse that is generated from position I (fig below) in the following figure propagates in the direction of II (fig below). ↓ Light ray A that is reflected at connection II in the figure is reflected again at connection I and propagates in the direction of II (fig below) as light ray

B. At this point, the 1131 detects A as an event. ↓ B is again reflected by connection II, and this generates reflected light ray C. At this point, the 1131 detects C as an event. Because the 1131 measures all the reflected light rays, A, C, and D, C is also detected as an event in the same manner that an actually generated reflection is. Therefore, while there is no actual event in this location, it appears as if an event has in fact occurred.



ANALYSIS OF WAVEFORMS / TRACES

EXAMPLE TRACE - 1

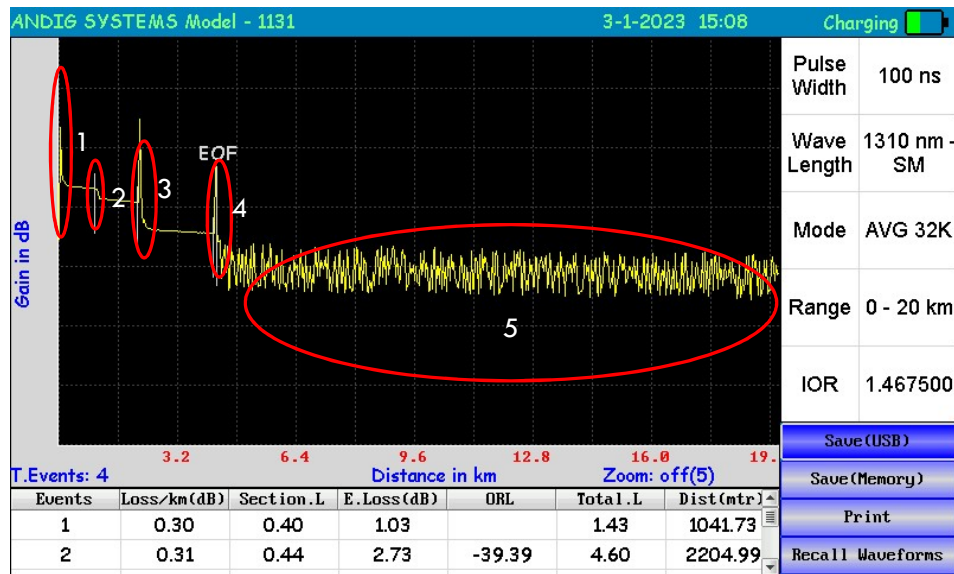


Analysis of Events in above trace :-

1. Reflective Event – The Event 1 (marked in red) connector shown in the above drawing is the incident pulse which is a reflective event caused due to the connector or OTDR port.
 - a. All other connectors and End of Fiber will produce such events characterised by a peak and a falling edge.
2. Good Connector - The Event 2 (marked in red) shown in the above figure is a reflective event characterised by gradual minimal peak.
3. EoF – End of Fiber. The last reflective event before the start of noise is the end of fiber. There are chances that the actual end of fiber may be buried in the noise , but the ANDIG OTDR has been programmed to indicate such an event only.

The last reflective event before the noise is considered as EoF.
4. The horizontal line between various events is the fiber that runs along the network.
5. The table gives the user the details such as Number of Events (T. Events :2), sectional loss , the loss per event & the cumulative loss from the start of the fiber till the End of Fiber.

EXAMPLE TRACE – 2

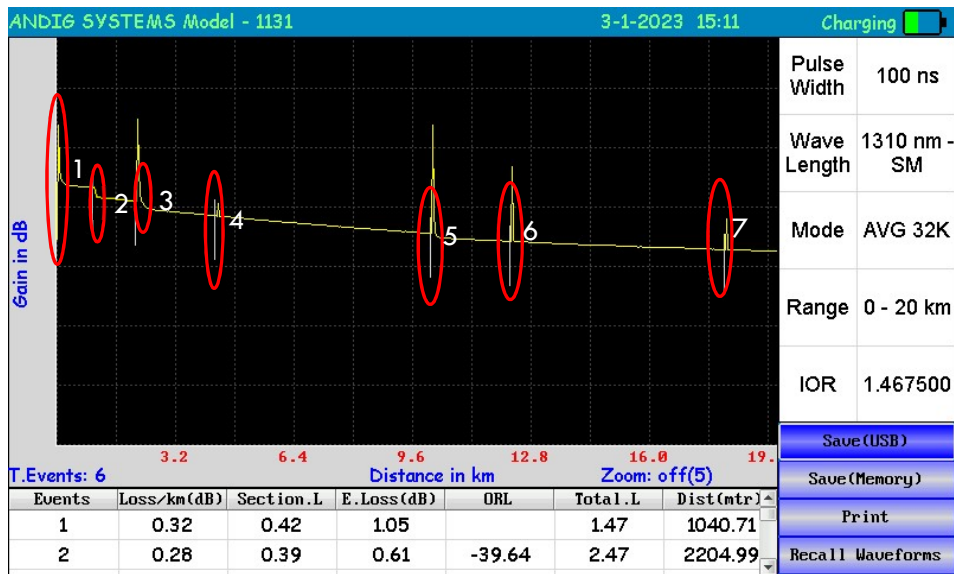


Analysis of Events in above trace :-

1. Reflective Event – The Event 1 (marked in red) connector shown in the above drawing is the incident pulse which is a reflective event caused due to the connector or OTDR port.
 - a. All other connectors and End of Fiber will produce such events characterised by a peak and a falling edge
2. Splice Event – This event 2 (marked in red) has an event loss of 1.03dBm at the distance of 1041.73 & is characterised by a falling edge only and no peaks are seen. It can also be seen as a rising edge (very rare) which will signify mismatched fibers spliced. In this case, it a falling edge only & no peaks, signifying a bad splice.
3. Reflective Event – The Event 3 (marked in red) connector shown in the above drawing is the reflective event with a loss of 2.73dBm at a distance of 2204.99mtrs caused due to the connector between spools of fiber.
4. Reflective Event – The Event 4 (marked in red) connector shown in the above drawing is the reflective event caused due to the terminating fiber / connector. The EoF marking is due to absence of fiber after the last reflective event.
5. The area marked as 5 is the noise that is seen after the End of Fiber.

The table can be scrolled down to see the other events.

EXAMPLE TRACE – 3



Analysis of Events in above trace :-

1. Reflective Event – The Event 1 (marked in red) connector shown in the above drawing is the incident pulse which is a reflective event caused due to the connector or OTDR port.
 - a. All other connectors and End of Fiber will produce such events characterised by a peak and a falling edge
2. Splice Event – This event 2 (marked in red) has an event loss of 1.03dBm at the distance of 1041.73 & is characterised by a falling edge only and no peaks are seen. It can also be seen as a rising edge (very rare) which will signify mismatched fibers spliced. In this case, it a falling edge only & no peaks, signifying a bad splice.
3. Reflective Event – The Event 3 (marked in red) connector shown in the above drawing is the reflective event with a loss of 2.73dBm at distance of 2204.99mtrs caused due to the connector between spools of fiber.
4. The events 4 (marked in red), event 5 (marked in red), event 6 (marked in red), event 7 (marked in red) are all reflective events.
5. The table gives the user the details such as Number of Events (T. Events :6), sectional loss , the loss per event & the cumulative loss from the start of the fiber till the End of Fiber.

NOTE THAT THE NOISE IS NOT VISIBLE AFTER THE LAST REFLECTIVE EVENT , ie EVENT no 7. HENCE EoF has not been declared.

EXAMPLE TRACE – 4



Analysis of Events in above trace :-

1. Reflective Event – The Event 1 (marked in red) connector shown in the above drawing is the first reflective event pulse which is a reflective event caused due to the connector or OTDR port.
2. The Event 2 is reflective event due to a connector.
3. The Event 3 is reflective event due to a connector.
4. The Event 4 is reflective event due to a connector.
5. The Event 5 is reflective event due to a connector.
6. The Event 6 is reflective event due to a connector.
7. The Event 7 is reflective event due to a connector.
8. The Event 8 is reflective event due to a connector.
9. The Event 9 is reflective event due to a connector but not marked in red.
10. The Event 10 is reflective event at a distance of 35729.27 mtrs or 35.729 km and is due to a connector but not marked in red. The event loss at Event no 10 is 0.40 dB
11. The table below shows the last 2 events , ie Event 10 & Event 11.
12. The Event 11 is final event, wherein the Event 11 is the End of Fiber at a distance of 40361.9 mtr or 40.361 km.
13. The table gives the user the details such as Number of Events (T. Events :11), sectional loss , the loss per event & the cumulative loss from the start of the fiber till the End of Fiber.

TABLE DATA INTERPRETATION :

T.Events: 6		Distance in km			Zoom: off(5)	
Events	Loss/km(dB)	Section.L	E.Loss(dB)	ORL	Total.L	Dist(mtr)
1	0.32	0.42	1.05		1.47	1040.71
2	0.28	0.39	0.61	-39.64	2.47	2204.99

The table scrolls down to reveal multiple events. To access the events table, press ESC button till the Save (USB) button is highlighted. Then press the Left Arrow key to highlight the table. The user can scroll down the events either by using the UP & Down arrow keys or by touch.

T.Events : The total number of events that have been captured is displayed here.

Event : The individual event & the information is listed .

Loss/km(dB) : This value gives you information of the loss in the fiber per km in dB.

Section. L : This is the section loss, ie it gives you information about the attenuation of the signal in a given section between 2 connectors or between 2 events.

E.Loss (dB) : This is the Event Loss. The actual loss in the event, ie the difference in power levels between the 2 positions that mark the start & the end of the event.

ORL : ORL stands for Optical Return loss is given in units of dB & always a negative value for passive optics, with values closer to 0 representing larger reflection (poorer connections)

Total.L : Total.L stands for Total Loss. The total loss is a cumulative total of section loss + event loss of every event. This is a close representation of the total loss in the system / network.

Distance : The distance in mtrs / meters is the distance of the event. The distance is calculated from the start of the fiber or start of the previous event.

LOSS CALCULATION USING CURSORS :



To calculate the loss using cursors or to find out the distance to an event using cursors, PRESS CUR button two times. Cursor A & Cursor B are displayed. The distance & the difference in attenuation between the 2 cursors is displayed at the top left of the screen.

Place cursors between 2 specific points of interest & the screen will display the distance & the associated difference between them.

Always coincide the cursors with the exact start of the event, i.e. the base of the rising pulse for a reflective event or the start of slope for a non reflective event. In case of a doubt, use the ZOOM function to ascertain the start of the event.

EoF (End of Fiber) interpretation:-

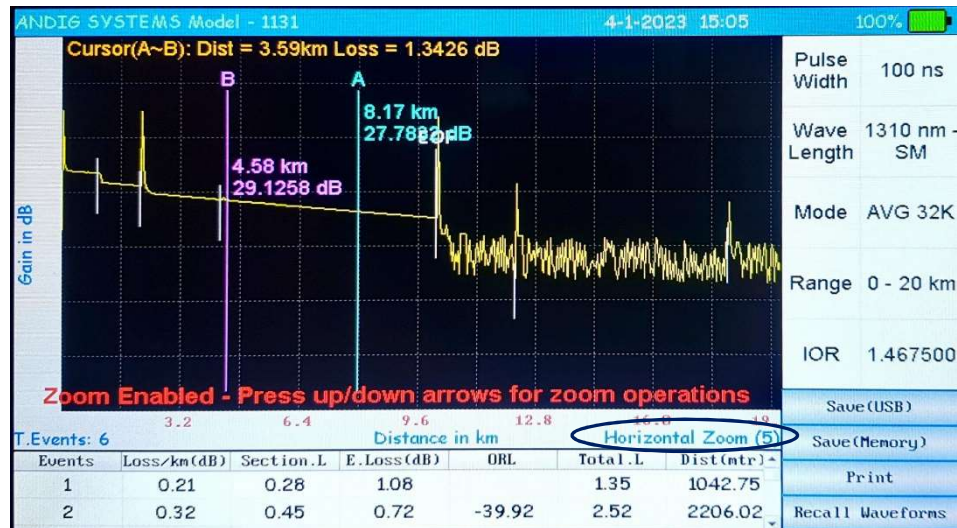
The OTDR has an EoF (End of Fiber) marker which is implemented such that the last reflective event before the trace signal merges with the noise is considered as End Of Fiber.

Users may see a reflective event embedded in the noise which the OTDR may disregard as End of Fiber. To ascertain the EoF is indeed the actual End Of Fiber, the user may increase the pulse width of the laser used thereby increasing the power delivered to the fiber under test.

HORIZONTAL & VERTICAL ZOOM :

To activate the horizontal & vertical zoom, PRESS ZOOM button. Horizontal zoom is activated first. If the user depresses the ZOOM key again, the vertical zoom is activated. An indication is shown on the screen as to which is the active zoom. The screenshot of the same is attached below for reference.

The zoom in zoom out of the trace is done using the UP & DOWN arrow key on the keypad or by pinch in or pinch out using 2 finger touch.



SOFT KEYS & FUNCTIONS (Displayed on the bottom right of the screen) :-

TO INITIATE THE USE OF THE SOFT KEYS, USER WILL HAVE TO PRESS ESC SO THAT THE Save (USB) button is highlighted.

Use of the up & down arrow keys , will select the other options in the SOFT BUTTON list.

Use of “ OK “ will confirm the selection.

Save (USB) :

The user can save / transfer the fiber trace viewed to a flash drive / USB provided in the accessories. Kindly connect the USB to the USB just above the DC Jack.

Print (Optional):

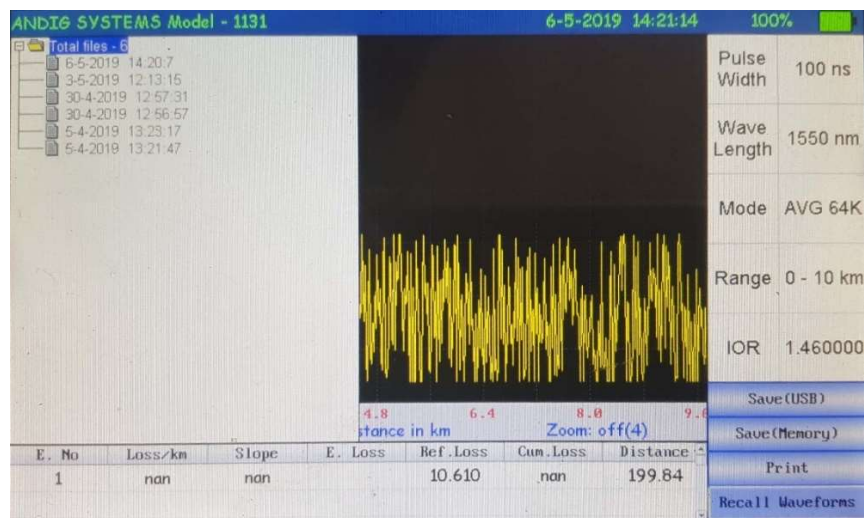
The user has the option of printing the screenshot if the printer is purchased as an additional accessory from ANDIG SYSTEMS. ANDIG uses proprietary printer hardware & hence this does not work with any standard printer. Kindly purchase the PRINTER from ANDIG only.

Save (Memory) :

The user has the option to save the screenshot in the internal memory card. The file is saved following a file naming nomenclature as “ddmmyyyyhrmmsec”.

Ex: - A trace viewed on 6th May 2019 at 14:20:19 is saved as “6-5-2019 14:20:7” as seen in the file structure.

FILE TREE STRUCTURE (Shown Below):



Recall Waveform / Detach Waveform :

- To store the waveform in the USB, use the appropriate soft buttons on the bottom right of the screen using the up/down arrow keys or via touch. Please note , the equipment will store the non editable BMP (picture format) of the screenshot along with the fiber trace file.
- You can recall upto 4 waveforms on the screen. To recall a stored waveform from internal memory (Save Memory) on the screen to compare with the current waveform, esc from the previous menus so that the bottom right soft buttons are highlighted. The recall waveform is to be selected after selecting the appropriate file from the files saved.
- Select the appropriate waveforms & use the right arrow button to highlight the OK option. Press OK button to display the waveforms.
- The recall waveform will change to “ Detach Waveform” when you want to remove the recalled waveform.
- Press “ Detach Waveform” to remove the display of stored waveforms.

Keypad Operations :



- **MENU** : Press to access the Main Menu which will let you select the AUTO , MANUAL mode & the settings menu.
- **ESC** : Press once to return to the previous menu. Press one or more times, depending on which menu or editor submenu is displayed, to return to the Home page.
- **CUR** : Press once to select Cursor A & Press again to select Cursor B. Blinking cursor is the current cursor. To shift from one cursor to the other , press CURSOR button again.
- **ZOOM** : To enable the zoom function on the LCD. Press Zoom once for Horizontal Zoom & Press Zoom again for Vertical Zoom. The type of zoom is indicated on the screen at the bottom of the graph as V.Zoom, which indicates VERTICAL ZOOM & H.Zoom which indicated HORIZONTAL ZOOM. Use the Up & Down arrow keys to zoom in or zoom out. When the max zoom in the particular range is reached, the system will prompt the user about the same.
- **SCAN** : It's the ORANGE key & Press to start the fiber test.
- **ARROW** : The arrow keys provide several functions as follows:
 - In the Main Menu, these keys are used to navigate menus and change setup parameters.
 - In the Trace Page, the Left and Right arrow keys are used to move cursors.
 - In the Zoom Adjust Page, these up & down keys are used to change horizontal and vertical zoom levels.
- **OK** : It has the functionality of the ENTER , It is used to confirm a particular selection of the menu.

Other Soft Touch Buttons displayed on the screen :

- **OTDR** : To select the OTDR function
- **OLS** : To select the Optical Light source function which uses the Laser of the OTDR in multiple mode
- **VFL** : To select the VFL (650nm – red laser)function
- **OPM** : To select the OPM module (if enables ONLY)
- **TDR** : To select the TDR module (if enables ONLY)
- **SETTING** : The ability to set the time, date & year, LCD brightness & format the internal storage is made available in this menu.
- **HELP** : To access the online manual saved in the OTDR memory.

OTDR Sub Menu Soft Keys :

- **AUTO** : This is a 1 key operation for the inexperienced user wherein the parameters are pre-loaded & the user has to only press the “ SCAN “ button to obtain the fiber trace / signature. The menu shall also prompt the default loaded settings on the screen for the information of the user.
- **MANUAL** : The mode which gives complete control on the parameter settings such as Wavelength, Pulse Width, Averaging, Distance, IOR, Fault threshold Sampling & Minimum fault tolerance (nREF).
- **PULSE WIDTH** : From 5ns to 20 us depending upon the fiber length can be set.
- **WAVE LENGTH** : User can select the 1310nm Laser or the 1550nm Laser which are the default Lasers. The equipment can also have the 1625nm or 850 nm or 1300nm Lasers as per the specifications during the order
- **MODE** :
 - Real Time – For live fiber trace, the user can select the REAL TIME from the drop down sub menu of the MODE drop down options.
 - Averaging – This mode is designed for removal / suppression of noise in the signal trace so that a cleaner signature may be viewed. The user can set a minimum averaging of 8k & increase it to 512K averaging . This averaging mode, repeats the process upto 512k times for better analysis.

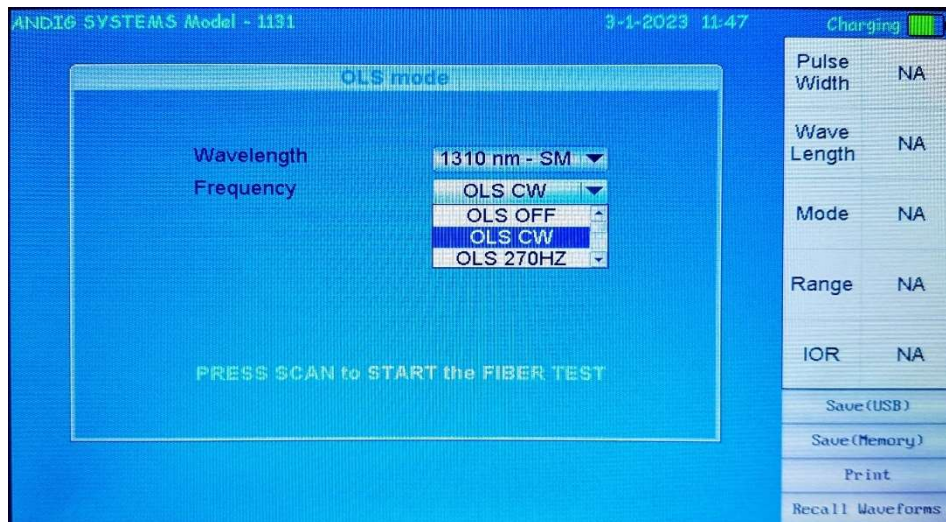
NOTE:- More averaging required additional processing time for analysis & display. Recommended averaging is 32K

- **DISTANCE** : If the user has prior information on the fiber length, then the same can be set in the drop down menu else he may set the parameter that is appropriate.
- **IOR** : Can be set from 1.460000 to 1.600000 by pressing the OK button.
- **Splitter Check** : Is always set to "NO"
- **Ref Event Loss** : Default values as per the pulse width are loaded
- **Non Ref Event Loss** : Default values as per the pulse width & distance are loaded

Trace page Features :

Scan	This is a graph of insertion loss vs. distance. The vertical axis shows loss in dBm. The horizontal axis shows distance in user-selected Distance units
Cursors	Used to measure loss, and distance. The active cursor can be moved by pressing either Left [<] or Right [>] arrow key. Press the -[Cur] key to toggle between the A and B cursors.
Cursor data field	This field displays A cursor location, B cursor location, distance from A to B in user-selected Distance units, and measured loss between A and B in dBm
Wavelength field	Displays test wavelengths of the currently displayed trace. For the dual-wavelength test (VFL/1310 nm or 1310/1550 nm), press the [lambda] key to toggle between the VFL and 1310 nm test results or between the 1310 nm and 1550 nm test results respectively. Note: the Highlight box around the wavelength value indicates the currently displayed wavelength.
Battery Indicator	Displays estimated battery status as follows: Green battery icon - battery is full Charging battery icon - battery is charging Red battery icon - battery requires recharging

Optical Light Source:



The Lasers installed in the OTDR are also set up for further use as a optical light source with a output of more than -7dBm. The OLS feature can be selected from the main menu & upon selecting the same , the following sub menu is displayed.

User can use the drop down option to select the 1310 / 1550nm lasers or other wavelengths as per models purchased. The modulation feature has 270 Hz, 1Khz , 2Khz and BLINK as options

The output of the OLS is via the same OTDR output port & there are no separate / dedicated port for the same. In case of quad wavelength, the output is via the same OTDR port meant for MM.

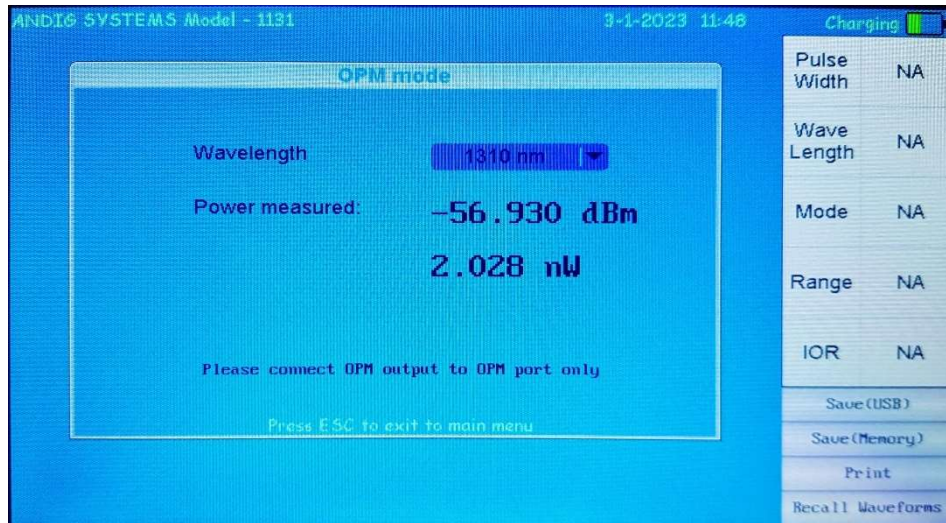
Press "SCAN" to initiate the output.

USAGE OF OLS for Loss Measurement :-

Please note , an Optical Power Meter is required at other end of the fiber.

1. Select OLS (1310nm) – CW mode, ie continuous mode.
2. Measure & Record the laser output from the OTDR using the OPM.
3. Disconnect the OPM & Connect the fiber under test to the Laser output.
4. Measure & Record the optical power at the other end using an OPM.
5. The difference between the direct reading of the OTDR & the reading at the far end will give the loss in the system.
6. Use the loss table on Page 13 & cross check if it is in acceptable limit.
7. Incase of excessive loss, use OTDR module to characterise the network.

OPM Module:



In the optical power meter module , the communication light (fiber in use) present in the optical fiber cable under measurement is detected & read as a digital signal by the A/D section at the OTDR a separate port, and its power level is measured.

The user has to use the drop down in the sub menu to choose the required wavelength. The display in in dBm & mW /pW or nW as the case maybe.

This is an optional & additional module that has to be specified during the purchase of the OTDR.

The user may choose the required range of the power meter measurement amongst the 2 options provided below.

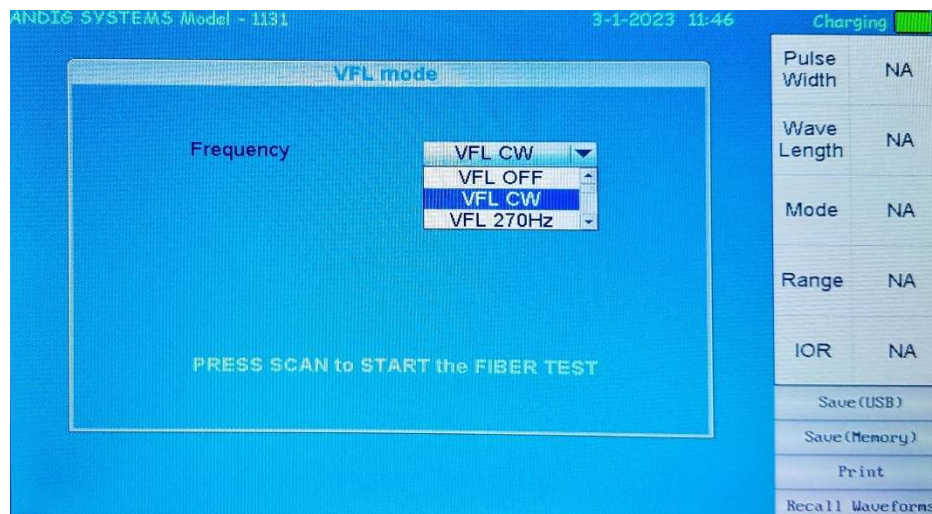
- a. + 20 dBm ~ - 50 dBm
- b. + 3 dBm ~ - 60dBm

The OPM module displays the power measurement for 1310nm , 1490nm , 1550nm & 1625nm wavelengths.

Press ESC to exit to main menu.

(Please note the touch functionality does not work for OPM module)

VFL Module – 650nm (VISIBLE RED LIGHT):



The VFL (visible light source) module is designed to test for breaks, connections, losses, and the like in optical fiber networks. The wavelength of the visible light source is 650 nm. Upon selecting the VFL option in the main menu , the sub menu is displayed. The VFL output selection is via a drop down menu using the “OK” button. The modulation feature has 270 Hz, 1Khz , 2Khz & VFL blink as options.

VFL blink is set to a timer of 1 sec pulse.

Press “SCAN” to initiate the output.

The output of the VFL is via a dedicated output port on the OTDR equipment.

USAGE OF VFL :-

To check the fiber that is to be laid / or to check the integrity of the fiber spool visually so that any breaks / excess losses are visible to the human eye.

1. Connect the fiber under test to the VFL output.
2. Select VFL – CW (Continuous Wave) or VFL – Blink as required.
3. Press SCAN to initiate scan.
4. Observe the fiber under test
 - a. The RED LIGHT will leak or be seen at the point of break or strain. If fiber is good, the light is seen at the end of fiber.
5. Please note the maximum distance the RED LIGHT will cover will be based on the output of the VFL.
6. ANDIG OTDR has a 10mW output and the maximum distance the laser can cover is 7~8km.

TDR Module & Features : (* Please check if this module has been opted for)

TDR Module:

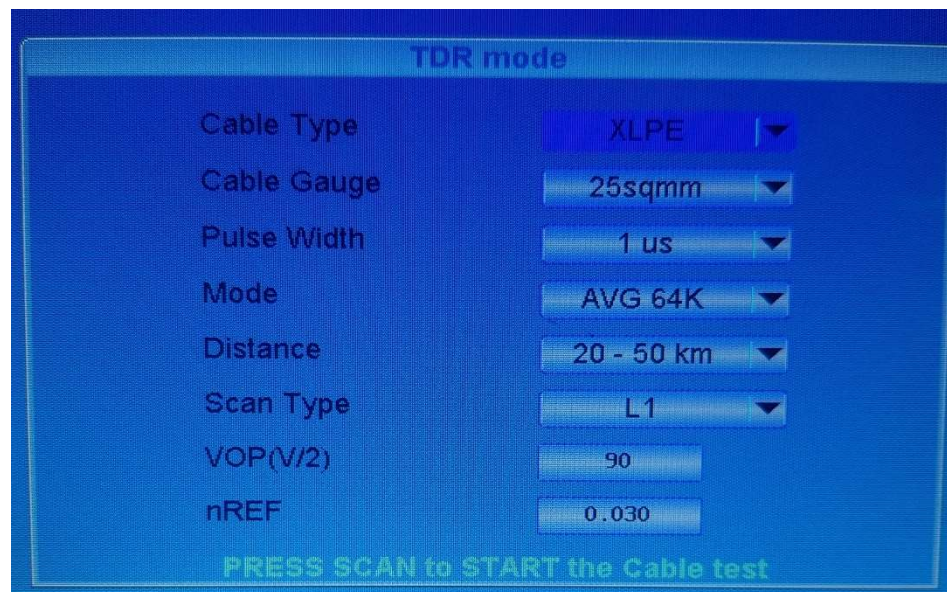
The TDR module can be used for copper or any metallic cable of various gauges. The menu & saving options are similar to the OTDR module. The input port for the TDR is via a BS-5 (Banana socket – 5mm Red & Black) ports on the top of the equipment.

The equipment has a TDR feature to measure the open & short faults of any fixed lines access. The equipment has incorporated all the latest features that are seen in the OTDR into the TDR module such as

1. Waveform storage (100 waveforms) & recall.
2. Waveform comparison between live trace & any saved waveform.
3. Waveform print via a handheld printer (* printer is not a standard accessory)
4. Waveform export to USB.

The line under test is connected to the BS (Banana socket) connector at the top of the equipment.

The user will have to select the TDR module in the main menu & select the test parameters.



TDR mode	
Cable Type	XLPE
Cable Gauge	25sqmm
Pulse Width	1 us
Mode	AVG 64K
Distance	20 - 50 km
Scan Type	L1
VOP(V/2)	90
nREF	0.030

PRESS SCAN to START the Cable test

The submenu options of the TDR mode are as below:

Cable Type : The following cable types are listed in the drop down menu

- a. Jelly
- b. Paper
- c. Co-Axial
- d. PVC
- e. XLPE

Cable Gauge : The following cable gauges are listed in the drop down menu

- a. 0.5 sq mm
- b. 0.9 sq mm
- c. 1.5 sq mm
- d. 2.5 sq mm
- e. 4 sq mm
- f. 25 sq mm
- g. 50 sq mm
- h. 75 sq mm
- i. 150 sq mm

Pulse width : The following pulse width are available & are listed in the drop down menu. The suggested maximum length of cable under test is also mentioned.

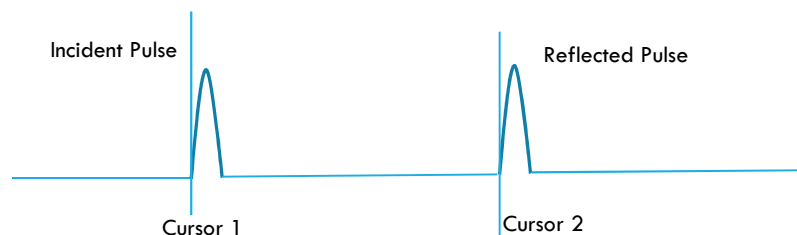
- a. 3 ns - for range upto than 500 mtrs
- b. 20 ns - for range upto than 500 mtrs
- c. 50 ns - for range upto than 1000 mtrs
- d. 100 ns - for range upto than 2000 mtrs
- e. 500 ns - for range upto than 5000 mtrs
- f. 1 us - for range upto than 10000 mtrs

VOP – The VOP functionality is an enhanced & smart functionality with a built in library of VOP for various types of cable & gauges. The appropriate VOP is already selected when the type of cable & gauge are selected , however the user has the flexibility to change them as required. For this, the user will then have to refer the cable manufacturer's datasheet for the exact VOP. The VOP will either set or recommend the appropriate value incase the set parameters are not a part of the predefined library functions. This helps the user to decide the appropriate VOP to set for the test.

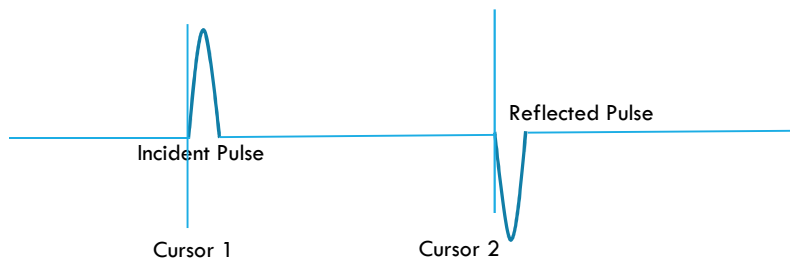
These menu sub options can be customised further as per customer requirement but care is taken to incorporate the most widely used cable in the telecom & power industry.

The TDR module works on a proven pulse reflection technique. A defined pulse is transmitted on a Cable Pair under test. The Pulse travels along the pair length at a fixed velocity of propagation depending on the dielectric of the cable. A part of the Pulse energy reflects back from the point where the characteristic impedance of Cable changes due to fault occurrences. The time taken by the pulse to reach the fault location & return to the source multiplied by the velocity of propagation gives twice the distance to fault.

For OPEN FAULTS: The waveform shown below is characteristic of open faults



For SHORT FAULTS: The waveform shown below is characteristic of short faults



The distance between the incident & reflected pulse is directly display at the top of the screen, which is the distance to fault.

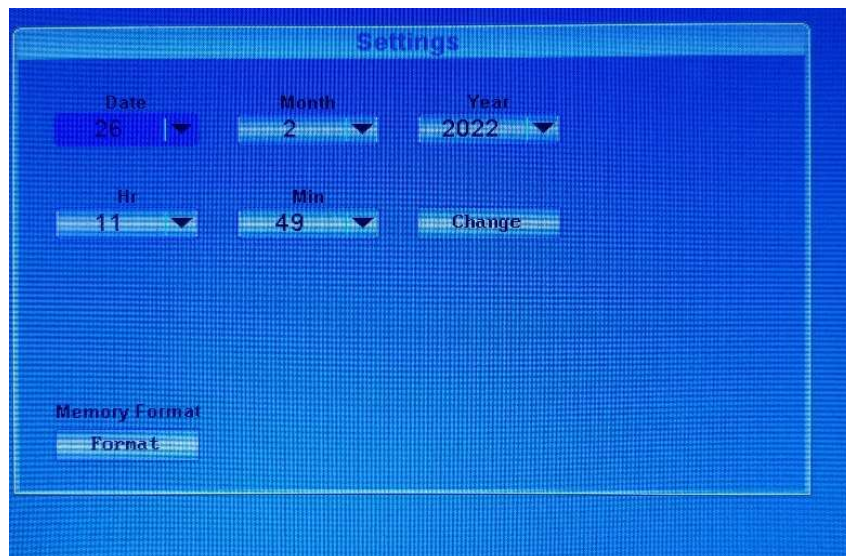
The enhanced features of the TDR are same as the features of the OTDR , wherein the user can see the power at any given instance along the cable giving him an approximate loss in the cable. Kindy note that unlike OFC , the loss shown in the TDR is only an approximate & varies with the condition of the cable.

As in the OTDR module, the distance to fault & the power loss between faults are displayed on the top of the screen. The values are linked to the Cursor 1 & Cursor 2, hence will change as the user moves any cursor.

Settings & Help Menu

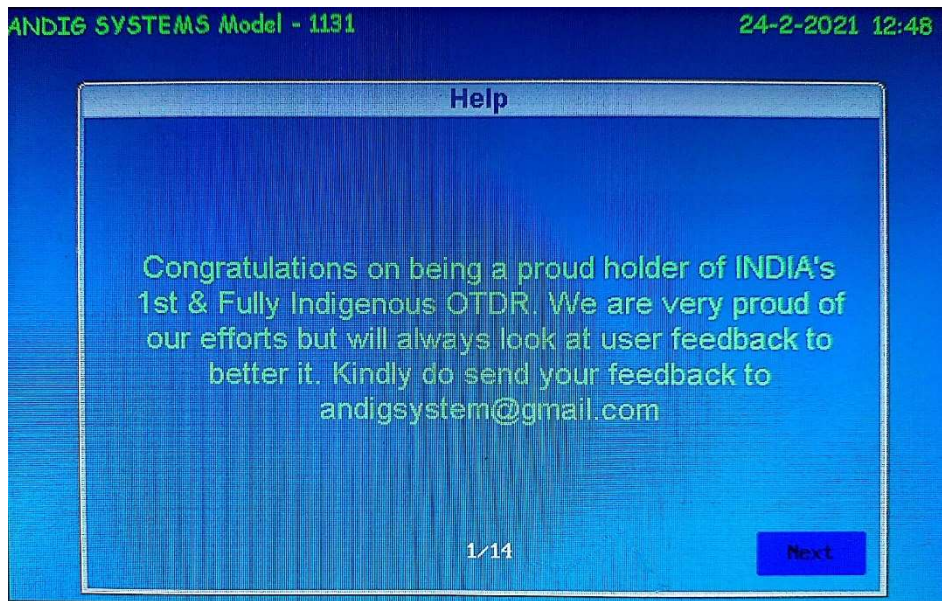
The setting menu is for

1. Setting / correcting the date - The OTDR has an internal battery & a RTC feature. Should the battery require replacement, kindly use this setup option to set the date & time.
2. Formatting the internal memory of the equipment - The internal memory of the equipment stores the .sor files of the signal trace for recalling in the future. The equipment can store multiple file & its size can vary depending upon the datapoints. The number of files that can be stored is based upon the type trace distances. Shorter trace distance consume less memory, while the larger trace consume more.
3. The number of files in storage can vary from 2000 to 50000 depending upon file size.



Help Menu :

Should you misplace / damage this manual, a brief explanation is uploaded into the memory of the equipment. This 14 page document is a ready reckoner for the user & can be accessed via the HELP menu in the main menu display page as shown below.



UNPACKING & REMOVAL OF PRESERVATIVES :

Housing Description - The equipment is housed in a plastic fluted case which has white coloured foam around the inside to protect the equipment from damage during storage / transit. The equipment is in a sturdy box with handle & locking mechanism as shown below.

There is no hardware or software installation to be done by the user.

Equipment ready to use directly from the box after unpacking



Equipment Front View



Equipment with protective Case & accessories on the side

Packing List :

- a. Open the fluted plastic packing box to reveal content inside.
The Contents are
 - i. OTDR – 1 no
 - ii. AC DC Adapter (10V/ 3 Amp) – 1 no
 - iii. Operation Manual – 1 no
 - iv. Launch Cable – 500mtrs (Optional)
 - v. USB – 1 nos
 - vi. 3" Thermal Handheld Printer – 1 no (Optional)

Preservatives - The equipment does not use any preservatives. However, we request you to kindly handle the equipment with care.

PREPARATION FOR USE & INSTALLATION PREFERENCES

“ANDIG” Model 1131 is pre-calibrated at factory. No field calibration is required. Modules that are selected at purchase are auto enabled.

- Remove Equipment from the protective case.
- Turn on the equipment & check if battery is sufficiently charged, else use the adapter to charge the equipment.
- Connect the Fiber under test to the OTDR output port.
 - Select OTDR module / applicable module
 - Select Auto / Manual Mode for OTDR test
 - Press “SCAN” to start the test for OTDR / OLS / VFL test
 - Connect the input cable to OPM module & Press OK
 - Connect to TDR port for metal cable & Press SCAN

Warranty

ANDIG SYSTEMS warrants this instrument to be free of defects in parts and workmanship for one year from date of shipment (a six month limited warranty applies to sensors and cables). If it should become necessary to return the instrument for service during or beyond the warranty period.

Kindly contact us 080 -23378976.

A Return Authorization (RA) number must be issued before any product is returned to Andig Systems. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification.

Andig Systems specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages.

Andig Systems' total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.

The minimum turn around time for repairs is 15 working days.

Calibration and Repair Services

Andig Systems offers repair and calibration services for the products we sell. Andig Systems also provides NABL tracability for the calibration certification for most products.

Andig Systems recommends that annual calibrations be performed to verify meter performance and accuracy.