

Fiber Optic Cable Series Troubleshooting

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1. Overview

This document presents a troubleshooting guide for fiber optic cables once deployed and in regular use. It also includes a list of common fault location items. Maintenance personnel can refer to this document for step-by-step troubleshooting when dealing with faults arising from the following sources.

1.1 Target Readers

This document is intended for the following engineers:

- ① Operation and maintenance engineers
- ② Installation engineers

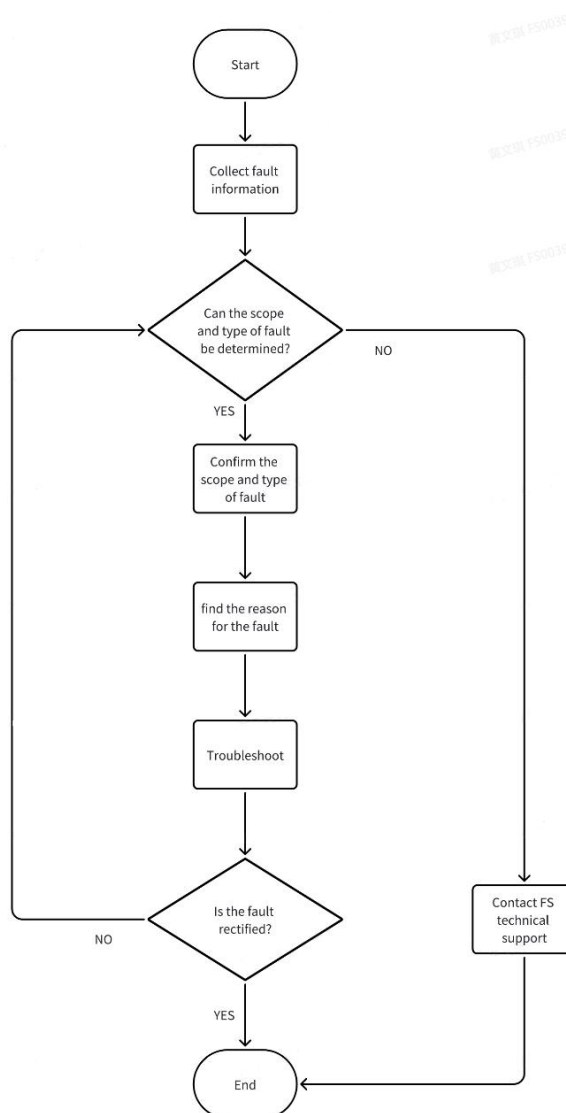
2. Content Introduction

2.1 Applicable Product Types

This document is applicable to fiber optic patch cable products, which are categorized into two types: conventional fiber optic cables and multi-core fiber optic cables. The classification is as follows:

- ① Conventional fiber optic cables: Cables with connectors such as LC, SC, FC, as well as high-density connectors like CS™, MDC, SN, etc.
- ② Multi-core fiber optic cables: Cables primarily use MTP® and MPO connectors.

2.2 Troubleshooting Process



Item	Step	Description
1	Collect fault information	Information serves as a crucial foundation for troubleshooting. Prior to addressing the fault, it is necessary to confirm the fault and collect relevant information.
2	Confirm the scope and type of fault	Based on the fault, ascertain the scope and type of fault: • If it can be determined, proceed to the next step. • If it cannot be determined, contact FS technical support.
3	Find the reason for the fault	Identify the cause of the fault based on the fault symptoms.
4	Troubleshoot	After identifying the cause of the fault, suitable measures can be implemented to resolve the issue.
5	Confirm if the fault has been rectified	After implementing measures, it is necessary to verify if the fault has been resolved: • If the fault has been eliminated, the troubleshooting process is complete. • If the fault persists, return to the step of "Can the scope and type of fault be determined?"
6	Contact FS technical support	If the scope and type of fault cannot be determined, or if the fault cannot be resolved, please contact FS technical support.

2.3 Fault Handling Tools and Instruments

The table below presents a selection of commonly used tools, instruments, and equipment. Instruments and equipment from different brands have distinct characteristics and functions.

Please refer to the following table to get more information.

Tool/Instrument	Recommended ID	Parameter	Description
Visual Fault Locators	#35388	The common wavelength is visible light 650nm, and the power range is 1mW to 30mW.	It is designed to be directly connected with the connector. In the event of an optical fiber breakpoint, a strong red light will be emitted at the breakpoint, aiding in the confirmation of the breakpoint location.
Fiber Optical Light Sources	#97568	Common typical wavelengths include 850nm, 1310nm, and 1550nm, which can be categorized into stable and regular light sources. Stable light sources exhibit wavelength stability and power stability compared to regular light sources.	During the troubleshooting process, the optical transceiver module can also be directly used as a light source for detecting the optical fiber link.
Optical Power Meter	#97488	Common typical wavelengths include 850nm, 1310nm, and 1550nm. There are conventional and MPO optical power meters available for detecting single/multicore cables. Depending on the specific scenarios, there are different power detection ranges available.	It is commonly used in conjunction with light sources to detect fiber link loss.
OTDR	#49651	Depending on the detection distance, different dynamic ranges are selected to perform testing using the principle of return loss. For measuring shorter cable lengths, an OTDR launch cable that avoids blind spots needs to be used in conjunction.	Used to measure characteristics such as reflection, scattering, attenuation, etc., in fiber optics. It can be used to detect faults or losses in fiber optic cables.
Fiber Connectors and Fiber Adapters	Connector:#48517 Adapter:#48488	Choose the appropriate connectors and adapters based on different connector types, such as LC, SC, FC, MTP®, etc.	In fiber optic testing, it is used for coupling.

Tool/Instrument	Recommended ID	Parameter	Description
MTP® Cassettes	12FTypeA:#57016 12FTypeAF:#57037 24FTypeA:#57341 24FType AF:#68540	MTP® end includes 8-fiber, 12-fiber, and 24-fiber categories, while the branch end includes connectors such as LC, SC, MDC, etc.	It can be used for coupling at either the MTP® end or the branch end, for troubleshooting purposes.
MTP® Polarity Conversion Tools	#80733	It features polarity conversion and male-to-female head conversion capabilities.	Designed exclusively for MTP® PRO connectors.
Cleaning Tools for Fiber Optic	Pen Cleaner:#39721 Clean Wipes:#162909	It includes alcohol, lint-free paper, and lint-free cloth.	Used to clean optical fibers or optical fiber end faces.
Fiber Optic Tool kit	#11404	It includes a cutting knife, stripping tool, heat shrink tubing, and more.	Used for repairing faulty fiber optic cables.
Fusion Splicer	#13325	Preheating time, fusion time, voltage/current, electrode pressure, etc.	Used to measure characteristics such as reflection, scattering, attenuation, etc., in fiber optics. It can be used to detect faults or losses in fiber optic cables.

3. Troubleshooting

3.1 Collecting Fault Information

The fault information that needs to be collected generally includes the following aspects:

- ① Time, location, frequency, and specific performance of fault
- ② Scope and impact of fault
- ③ Operating status before the fault
- ④ Actions performed on the equipment before the fault occurred and the outcomes of those actions
- ⑤ Measures taken and their results

3.2 Confirm the Scope and Type of the Fault

The table below presents the primary faults of fiber optic cables. By employing an enumerative method based on the collected fault information, the fault can be comprehensively determined.

Please refer to the following table to get more information.

Specific Fault	Description
Fault Type : Parameter-related Fault	
Abnormal connection loss	The issue is characterized by normal optical fiber loss, but experiencing excessive loss after connecting the connector.
Abnormal transmission loss	The issue manifests as fiber loss per kilometer exceeding the standard value, resulting in the inability of the terminal equipment to receive optical signals.
Abnormal bending loss	The issue is characterized by an abnormal increase in loss, signal distortion, packet loss, and error codes in terminal equipment when the fiber is bent within a reasonable range.
Dispersion issue	The symptoms include signal distortion, poor eye diagram closure, and impulse broadening occurring when the optical signal reaches the other end.

Specific Fault	Description
Fault Type : Application-related Fault	
Wrong polarity	The symptoms are the inability to establish a link and the module not receiving any optical signal.
Fiber break	The symptoms are the inability to establish a link and the module not receiving any optical signal.
Fiber abnormal point	The symptom is an abnormal increase in fiber loss after adding a specific node to the link, or the presence of abnormal events observed in the graph through OTDR.
Transmission distance	The symptom is that the fiber link fails to achieve the rated transmission distance of the module.
Problems in components such as connector	The issue manifests as installation problems with connectors, resulting in the inability to properly install them onto modules, panels and adapters.

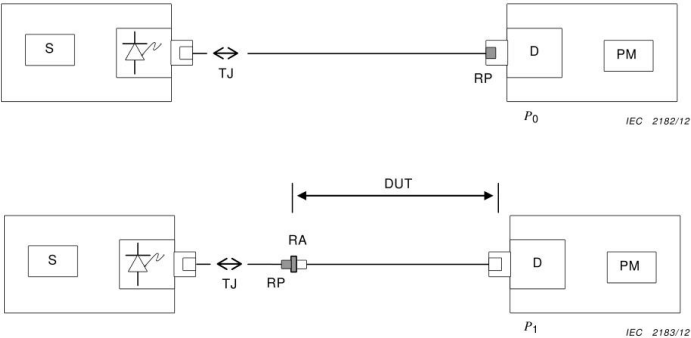
3.3 Fault Localization

Fault localization can be confirmed through replacement testing using the control variable method. The following measures correspond to different fault scopes and types for fault localization:

Specific Fault	Description
Fault Type : Parameter-related Fault	
Abnormal connection loss	To test the connector loss on both ends of the fiber, you can refer to the IEC 61300-3-4 standard Type B.

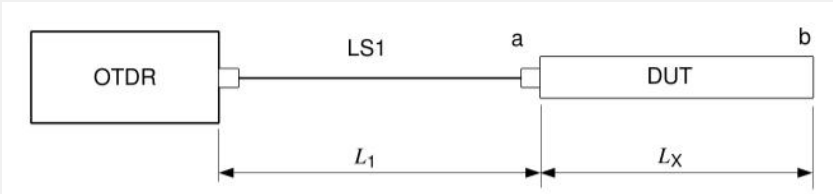
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61300-3-4 © IEC:2012

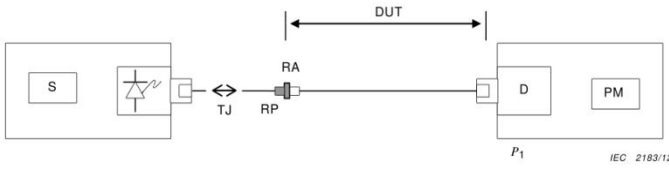


- If the issue is resolved after replacing the optical fiber connector, it can be concluded that there was an abnormal connection loss in the fiber optic cable.

Abnormal transmission loss	Measure link loss through OTDR (be careful to avoid OTDR blind zone L1).
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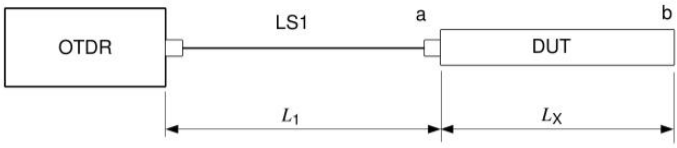


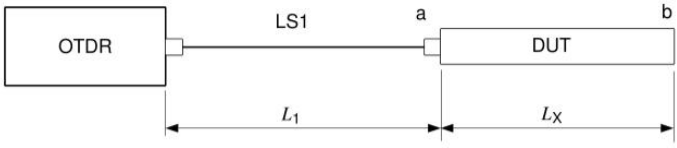
- If the problem is resolved after replacing the optical fiber in this link, it can be concluded that there was an abnormal transmission loss in the fiber optic cable.

Specific Fault	Description
Abnormal bending loss	- Connect the DUT(Device Under Test) separately to the light source end and the Optical Power Meter (OPM) end, and gradually bend the optical fiber to check the loss/power change status of the OPM end.  - If the problem is resolved after replacing the optical fiber in this link, it can be concluded that there was an abnormal bend loss in the fiber optic cable.
Dispersion issue	If the problem is resolved after replacing the optical fiber in this link, it can be concluded that there was a dispersion issue in the fiber optic cable.
Fiber end-face cleanliness issue	- Use the fiber end face detector to check if there is dirt in the core area of the fiber end face. - If the problem is resolved after replacing the optical fiber in this link, it can be concluded that there was an end-face issue in the fiber optic cable.
End-face geometry dimension issue	If the problem is resolved after replacing the optical fiber in this link, it can be determined that the issue originated from this optical fiber.

Fault Type : Application-related Fault

Wrong polarity	- For shorter conventional fiber cables, polarity can be visually checked, while for longer or pre-installed conventional fiber cables, polarity can be verified using an optical power meter. In the case of MTP®/MPO fiber cables, a polarity tester or an MTP®/MPO cassette can be employed for testing. A visual fault locator can be used to verify the fiber line sequence. For more detailed information on polarity, please refer to the <i>Fiber Polarity Technical White Paper</i>. - If the issue is resolved after replacing the fiber optic cable with a different polarity, it can be concluded that there was a polarity mismatch.
Fiber break	If an abnormal red light spot appears when using a visual fault locator, and the opposite end does not receive any optical power, it can be confirmed that the fiber is broken.

Fiber abnormal point	- Measure link loss through OTDR (be careful to avoid OTDR blind zone L1).  - If the problem is resolved after replacing the optical fiber in this link, it can be concluded that there was an abnormal loss in the fiber optic connection.
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Transmission distance	- Measure link loss through OTDR (be careful to avoid OTDR blind zone L1).  - If the link loss is within the normal range, it indicates that the issue is not related to optical fiber, and attention should be given to optical modules/equipment on both ends.
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Specific Fault	Description
Problems in components such as connector	If the problem is resolved after replacing the optical fiber in this link, it can be determined that the issue originated from this optical fiber.

3.4 Fault Exclusion

For the issues listed above, if verified by the user or through FS tests, the following methods can be employed to exclude the fault.

Specific Fault	Description
Fault Type : Parameter-related Fault	
Abnormal connection loss	- After cutting the connector head, replace it with a quick connector. - Replace optical fiber.
Abnormal transmission loss	Confirm the locations of abnormalities and perform fiber re-splicing.
Abnormal bending loss	- Avoid bends during wiring. - Replace optical fiber.
Dispersion issue	Replace optical fiber.
Fiber end-face cleanliness issue	- Use dust-free paper and alcohol to clean the fiber end face. When cleaning, it is necessary to present a vertical direction and wipe horizontally. - Replace optical fiber.
End-face geometry dimension issue	Replace optical fiber.
Fault Type : Application-related Fault	
Wrong polarity	- Manually reverse polarity. - Replace optical fiber with correct polarity. - Repair using polarity conversion tool (e.g. MTP® PRO connector).
Fiber break	- Confirm the locations of abnormalities and perform fiber re-splicing. - Replace optical fiber.
Fiber abnormal point	Confirm the abnormal point, re-splice or re-couple.
Transmission distance	Verify the parameters and functions of the modules on both ends.
Problems in components such as connector	Replace optical fiber.

3.5 Confirm If the Fault Has Been Rectified

Based on the collected fault information, utilize testing instruments or directly apply to the operational system. This is done to ensure that the fault has been rectified and business operations have returned to normal.

3.6 Contacting FS Technical Support

If the scope and type of fault cannot be determined, or if the fault cannot be resolved, please reach out to FS sales personnel or technical support for assistance.

When seeking FS technical support during the troubleshooting process, it is recommended to prepare the information outlined in "3.1 Collecting Fault Information" in advance. This will help resolve the problem more quickly and effectively.