

AROONA-STAR

Harness the full potential of optical fibers

Don't be limited at 100 Mb/s!
AROONA-STAR offers up to 6 multimode fiber links at 10 Gb/s, without having to change fibers.

Instruction Manual

CAILabs
Shaping the light



AROONA-STAR

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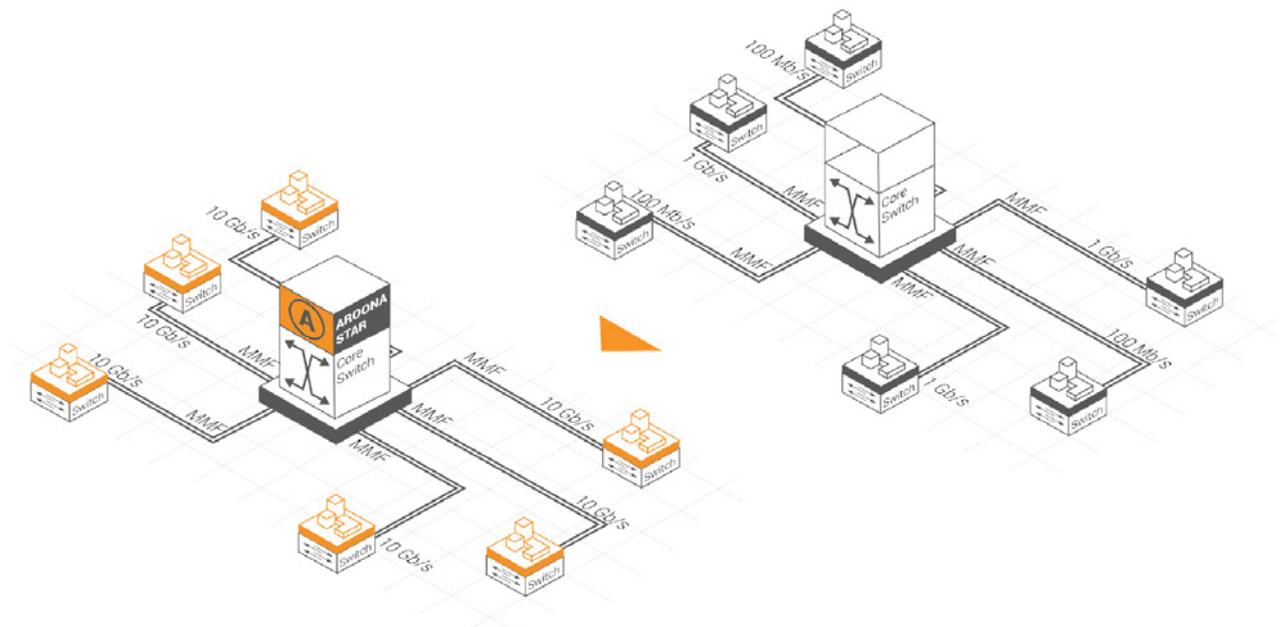
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1. INTRODUCTION

The AROONA series gives your LAN a new youth. AROONA-STAR devices are mode adapters that enable you to upgrade your multimode link capacity.

A single AROONA-STAR device allows you to simultaneously upgrade as many as 6 multimode fiber links from your network infrastructure.

This manual presents the AROONA-STAR solution, its technology and user instructions. This user guide also addresses how to install and connect AROONA-STAR equipment to your optical link.



1.1 Technical support

If you have any problems after reading this manual or while using AROONA equipment, please contact CAILabs' technical support.

To contact technical support:

Web: www.cailabs.com/support

Email: contact@cailabs.com

Phone: +33 9 77 21 63 96

1.2 Warranty

According to Article 10 "Warranty" of the General Terms and Conditions, CAILabs' products are warranted to be free from defects, valid at the moment of purchase.

2. PRODUCT OVERVIEW

2.1 Description

Simply installed in the network core, the AROONA-STAR solution increases the capacity of 6 links of a network architecture in star topology to 10 Gb/s without having to undergo a long, complex and expensive new fiber roll-out. The system is passive and independent of the communication protocol used. It works with commercial single-mode transceivers at 1310 nm. AROONA-STAR is also compatible with WDM technologies, allowing a flexible and progressive increase in capacity of the network to high bit rates while also future-proofing the cable infrastructure.

2.2 MPLC technology and mode group multiplexing

Standard multimode fibers with gradient index profile, OM1-2-3-4 type, have linear polarized modes called LP with degenerate propagation constants LP_{ij} . Degenerate modes couple very strongly within their mode group, while modes from distinct mode groups are much more isolated and can be considered independent transmission channels within the same optical fiber.

Standard multimode fibers can support dozens of modes divided into a few mode groups. The AROONA-STAR solution uses the first mode of the fiber- LP_{01} -and by minimizing the modal crosstalk during propagation, a quasi-single-mode transmission over a multimode fiber is obtained. AROONA-STAR thus allows the use of the fundamental mode of the multimode fiber as a way to avoid modal dispersion, which limits the bandwidth of this type of optical fiber.

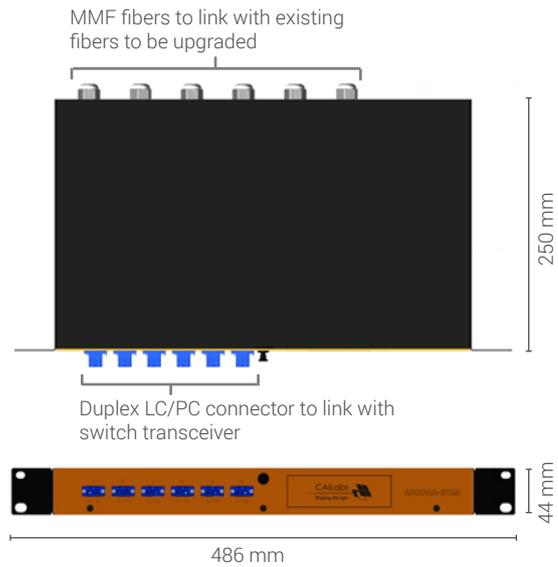
The modal conversion from single-mode input channels to multimode fiber fundamental mode is efficiently achieved through Multi-Plan Light Conversion technology, patented in 2009.

The conversion is performed with high mode selectivity and high coupling efficiency, thereby limiting modal crosstalk.

2.3 Technical specifications

AROONA-STAR equipment dimensions:
H: 44 mm x L: 486 mm x P: 250 mm (1U 19" rack)

The technical specifications of AROONA-STAR equipment are listed below:



PARAMETER	AROONA-STAR
Operating wavelength	O-band (1310 nm)
Reach	< 800 m
Number of duplex channels	Up to 6
System capacity	10 Gb/s per channel - Compatible with WDM Independent data rate over each channel
Insertion loss	4 dB (typical: 2.5 dB)
Communication protocol	Transparent to standard protocols (Ethernet, Fiber Channel, etc)
Compatible transceivers	Any type of single-mode transceiver in O-Band (1000BASE-LX or 10GBASE-LR type) Format : SFP, SFP+, XFP, GBIC, XENPACK, X2

3. GETTING STARTED WITH AROONA-STAR EQUIPMENT

In each pack, there is one AROONA-STAR device:

AROONA-STAR racks are 19" 1U racks.

In each AROONA-STAR package, there is a small bag of items required for the installation process.

List of items:

- 4 M6 cage nuts
- 4 M6 pan head screws
- 4 M6 black nylon flange washers
- 4 plastic bases
- 8 plastic straps
- 2 white stickers
- 24 thermo-retractable sheaths (from 3 mm to 1 mm)
- 12 thermo-retractable fiber fusion splice protection sleeves
- 2 splice trays

AROONA-STAR equipment is sent by CAILabs ready-to-work. No configuration is necessary once the installation process has been completed.

4. EQUIPMENT INSTALLATION

4.1 Recommendations

This section details how to install the AROONA-STAR racks (H: 44 mm x L: 486 mm x P: 250 mm, 1U rack) on a standard 19-inch storage bay and how to connect the multimode fibers to be upgraded. The instructions and operations for the AROONA-STAR rack listed below only need to be applied to one end of the link to be upgraded.



CAILabs advises that the installation be completed by two people for safety reasons.

Choose a space for the AROONA-STAR that isn't too far from the optical drawer containing the fiber you wish to upgrade. Make sure that the distance between the AROONA-STAR fiber and the fibers to be upgraded is large enough to splice the fibers together.

Warning: To prevent injuries while fixing the product in the storage bay, take precautions to guarantee system stability.

The following connection steps allow for the upgrade of one multimode fiber pair. Please repeat the connection steps for each pair of fibers that you wish to connect to an AROONA-STAR channel.

4.2 Connection set-up

a. Your optical drawer



a. Your optical drawer

1. Open the optical drawer containing the fibers and identify the multimode fiber pair to be upgraded. If identifying fibers is difficult, do not hesitate to find a way to identify them for the rest of the process.
2. Cut the connectors at the fibers' end.

Warning: Fiber lengths usually available are short. It is important to maximize available fiber length to facilitate splicing operations.

b. AROONA-STAR rack

1. First of all, it is necessary to locate the multimode fiber pair coming out of the AROONA-STAR rack, corresponding to the channel you wish to upgrade. Marking rings, numbered 1 to 6, allow the associated fibers to be identified.
2. Make sure that the fiber length at the AROONA rack output is long enough to reach the rack where the production fibers are in order to proceed connection. Make sure you have more fiber length than requested.

NB: Be careful not to bend or constrict the fiber in any way. Excess fiber can be cut or coiled and fixed to the network bay.

3. Insert the AROONA-STAR rack in the network storage bay.

NB: Make sure you have easy access to fibers before inserting and fixing the AROONA-STAR rack in the storage bay.

The AROONA-STAR rack must be fixed to the frontside of the storage bay with the 4 cage nuts and 4 screws provided. In a partially-full storage bay, charge it from bottom to top and make sure heavier equipment is placed on the bottom.

If a stabilization system is provided with the storage bay, please install before fixing the AROONA-STAR rack.

Note: AROONA-STAR is a passive solution and it is thereby unnecessary to ground the equipment.

b. AROONA-STAR rack



4.3 Connection of AROONA-STAR equipment to multimode production fibers

a. Splicing principle

1.



Fiber connection must follow certain rules and methods in order to:

- respect the bending radius of fibers and cables;
- provide a pathway for fibers limiting breaking risks and post-installation macro or micro bending;
- identify different connections and fibers to ease the use and evolution of the network.

2.



When the AROONA-STAR rack is installed in the storage bay according to accessibility conditions of the upgraded multimode fiber rack, the next step is to perform the splice between the output multimode fiber of the AROONA-STAR rack and the deployed multimode fiber to be upgraded.

Note: Splicing is the most important step during AROONA-STAR installation. A poor-quality connection will have a significant impact on the performance of the AROONA-STAR solution.

3.



There are 2 splicing methods: mechanical splicing and fusion splicing.

- Mechanical splicing is done with a tool that aligns fiber cladding and maintains contact with the fibers.

Warning: To use AROONA-STAR equipment under optimal conditions, we strongly recommend that you do not use mechanical splicing for the connection.

4.



- Fusion splicing is done with a fusion splicer that aligns and connects two prepared fibers by merging with an electrical arc. It is necessary to prepare the fibers beforehand so that they are ready to be spliced by fusion.

5.



For the connection process, you must have the following set of tools:

- Optical fusion splicer¹
- Lint-free wipers²
- Cleaning solvent for fibers (isopropyl alcohol or isopropanol or ethanol)³

6.



- Kevlar scissors⁴
- Stripper for cable and optical fiber⁵
- Optical fiber cleaver⁶
- Thermo-retractable fiber fusion splice protection sleeves⁷

- Thermo-retractable sheaths⁸

Note: Splice protective sleeves and thermo-retractable sheaths are provided with each AROONA-STAR rack.

b. Splicing process

To perform a splice, follow these steps:

1. Identify the two fibers you wish to splice together (production fiber and the AROONA-STAR output fiber).

Note: It is possible to use the white stickers provided as a way to identify production fibers.

2. Prepare both fiber ends for the splicing process. Bare a few centimeters (3 to 6 cm) of the fiber with the stripper. You must first cut the connector of the production fiber. According to cable structures, it may have few layers to bare (1-3mm plastic cladding, Kevlar protection, 900 µm plastic coating and 250 µm polymer coating).

Note: Use adapted scissors to cut the wired Kevlar structure and an adapted stripper for each cable diameter.

3. Thread splice protective sleeve and thermo-retractable sheath before proceeding to the following cleaving operation.
4. Properly clean the nude part of the fiber with the solvent and lint-free wiper.
5. Take the cleaver, which allows for precise cleaning of the fiber at an angle of 90°. This tool is essential to connecting the two fibers at an identical cutting angle. The fiber is cleaved through a “scratch and break” method.
6. Once the fibers are cleaved, put them in the dedicated guide in the optical splice (V-groove, holder...).

Note: If you forget to thread splice protective sleeves, remove the fiber, put the protective sleeve on it and then repeat the cleaving operation.

7. Examine cleave quality on the splicer control screen. The end of the fiber should appear plain with no defects, ridges or cracks that spread into the fiber core. CAILabs also recommends a minimum cleave angle of 2° for optimal splicing. If you consider the cleave quality unsuitable, it is better to repeat the operation rather than place the fiber in the optical splicer.
8. On the optical fusion splicer, select the mode corresponding to standard multimode fibers (MM = multimode = cladding alignment).

Start the splice in automatic mode.

9. Once the splice is completed, gently remove the fiber from the fusion splicer.

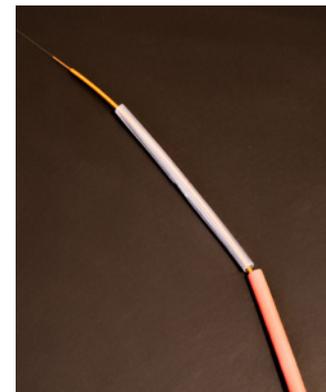


7.

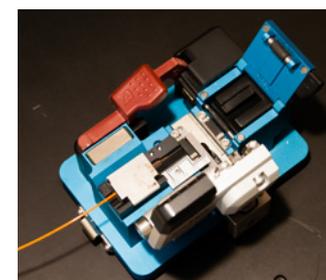


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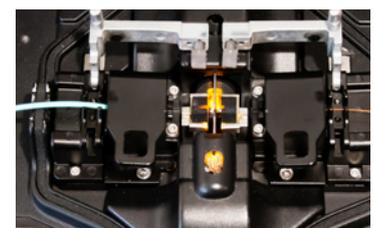
b. Splicing process



2.



5.



6.

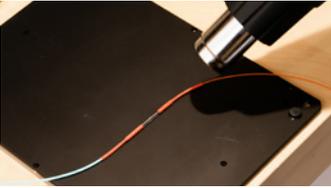


7.

12.



14.



10. Put the protective sleeve on the splice so that the bare part of the fibers are covered.
11. Put the splice protective sleeve in the shrinking oven of the optical splicer. The protective sleeve protects the spliced fiber so that the bare area, which is potentially weakened, is reinforced.
12. The splice protective sleeves are available in several sizes: 40 mm, 45 mm and 60 mm. CAILabs advises you to use a 60 mm protective sleeves in order to cover all of the fiber's bare area (125 μ m cladding diameter).
13. Next, put the thermo-retractable sheaths on the splice protective sleeve. Heat the sheath with a heat gun. The thermo-retractable sheaths are going to cover and protect the bare area of the fiber cable.
14. When the splice is completed, replace the fiber in the original rack of the multimode fibers to be upgraded. A splice tray is provided for this step, but not essential. If there is not sufficient space for the splice tray, secure the splice protective sleeve with scotch tape to the rack.
15. Close the rack of multimode fibers. If there is excess optical cable at the output of the AROONA-STAR rack, wind this part of the fiber cable and fix it to the storage bay with the plastic strap provided.

4.4 Connection of different fiber sections in case of intermediate connectors on the link

It is possible that the multimode fiber link to be upgraded is made up of a concatenation of different fiber sections, with potential intermediate optical patchcords in network bays. These intermediate connection points indicate the presence of optical connectors.

Optical connectors have eccentricity tolerances of a few micrometers which do not allow for optimal optical core alignment for mode group multiplexing. These intermediate connectors must be removed in order to ensure proper modal alignment and thereby increase transmission performances over the multimode link.

MPLC technology actually allows distinct modes to be excited within the optical multimode fiber. This precise modal excitation must be preserved throughout the transmission to overcome the physical phenomenon of modal dispersion, which intrinsically limits the bandwidth of multimode fibers.

To avoid modal misalignment due to intermediate connectors, it is necessary to replace each connector by fiber splicing.

Note: A reflectometry measurement of the link to be upgraded may allow all intermediate connectors to be identified.

5. USING AROONA-STAR

5.1 Transceivers compatibility

AROONA-STAR solution is compatible with all types of commercial single-mode transceivers that can be found on the active network equipment of various manufacturers (SFP, SFP+, XFP, XENPACK, X2, GBIC).

Transceivers are available with a large range of transmitters and receivers. This allows users to select a transmitter-receiver pair with an appropriate optical budget, ensuring suitable distance range on the fiber.

Recommended transceivers for using AROONA-STAR equipment are single-mode transceivers over O-band (~1310 nm), such as 1000BASE-LX for 1 Gb/s bit rate or 10GBASE-LR for 10 Gb/s bit rate.

In addition, AROONA-STAR equipment is invisible to the communication protocol used (Ethernet, FiberChannel, SONET/SDH, OTN, etc.)

5.2 Operating AROONA-STAR

The AROONA-STAR solution can be used on several types of networks. This solution is recommended for upgrading multimode fiber links in a star network topology.

The AROONA-STAR equipment must be placed at the network core, where the multimode fibers you wish to upgrade capacities are located. No equipment installation is required at the other end of the fiber link.

Once AROONA-STAR has been installed, that is, once splicing has been completed between multimode fibers and AROONA-STAR and the intermediate connectors have been replaced by fiber splicing, you can operate AROONA-STAR.

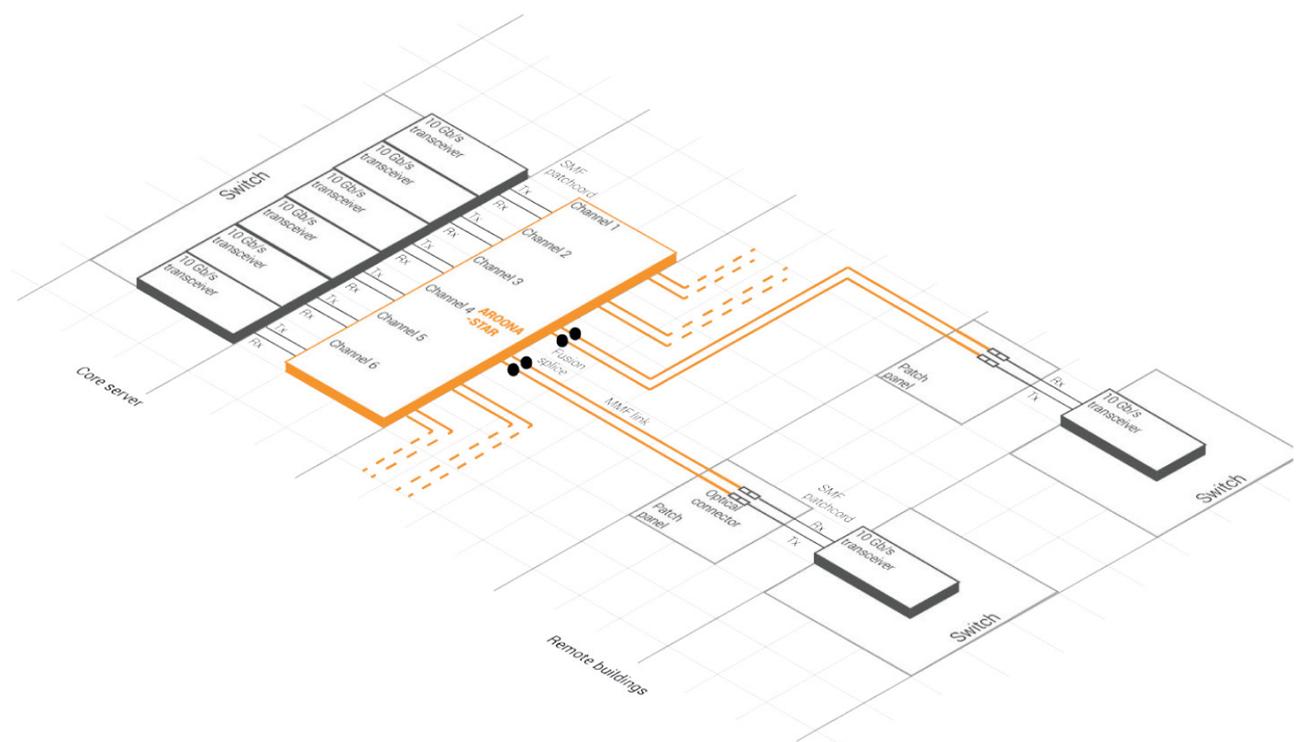
Each channel of AROONA-STAR can be used independently.

To use a transmission channel, first make sure that the suitable transceiver is inserted into the switch on both sides of the upgraded fiber link. After that, connecting the transceiver to the AROONA-STAR ports must be made using single mode patchcords (SM – 9/125µm). You must also use single-mode patchcords between the end of upgraded multimode fibers and the termination transceiver.

On the AROONA-STAR equipment side, the Tx port of the channel you wish to use must be connected to the Tx output port of the transceiver. The Rx port of the same channel must be connected to the Rx input port of the transceiver.

Repeat the same procedure for each AROONA-STAR channel of you wish to operate.

Note: To know which transceivers to use with AROONA, refer to section 5.1 of this guide. To obtain detailed instructions about installation, transceiver module connection or removal, please refer to the guide provided with the transceiver or the switch.



6. TROUBLESHOOTING

6.1 Connectors cleaning instructions

Under normal conditions of use, AROONA-STAR equipment requires little maintenance. The only possible maintenance for the user is cleaning the optical connectors.

If an AROONA-STAR channel is not used, we advise that the protective cap on the connectors be left on in order to avoid the accumulation of dust on the fiber end, which could lead to additional losses when operating this channel.

A reliable fiber network must have clean and well-maintained connectors. Therefore, before inserting a connector, it is essential that it be clean, without any defects. In the case that it is not, it is necessary to clean it.

To clean the input and output connectors of a channel, refer to the standard cleaning procedure of a LC/PC connector.

There are two methods of cleaning: cleaning with a solvent and dry cleaning. Combining both methods allows for the removal of all contaminants on a connector extremity.

a. Dry-cleaning

This type of fiber cleaning is particularly efficient when contaminants are tiny dust particles or solvent residues.

To do the cleaning, use dry air spray. Spray on the connector end or on the input or output connector jumper of a channel so that you can clean the connectors within AROONA-STAR equipment.

Certain dry-cleaning systems exist in the form of cartridge (ReelCleaner/Cletop), where only few straight back and forth movements with the connector on the cleaning wipe are enough to remove dirt.

For AROONA-STAR equipment connectors, certain dry-cleaning systems exist (i.e. CleanConnect), which allow you to put the tool inside the connector jumper on the frontside of the rack and then perform an optimal cleaning of it.

b. Cleaning with a solvent

The goal of this cleaning method is to remove dust, grease or hand sebum residue from a connector without scratching or damaging it. For patchcord connectors, use an optical cleaning paper/wipe (generally in polyester and cellulose).

Soak a small quantity of appropriate solvent (isopropyl or isopropanol alcohol) on a piece of wipe. Then, put the connector end on the moist part of cleaning wipe.

Gently make a few straight back and forth movements, without applying too much pressure on the connector nor lifting it up, from the moist part to the dry part. Avoid circular movements as the contaminants removed could fall onto the optical side of the connector. Two or three movements are sufficient. Do not place the connector on the same place on the wipe.

For AROONA-STAR connectors (channels input/output), we advise you to use an appropriate non-fluffy cotton bud for optical cleaning. With or without a solvent, you must carefully work your way into the connector. Gently make a few rotations with the cotton bud so that contaminants are removed at the extremity of the connector.

Note: If you have an inspection tool (microscope or inspection probe), check the connector extremity to make sure there isn't any residue left and that the connector is neither scratched nor damaged.

Remark: If you have an inspection tool (microscope or inspection probe), check the connector extremity to make sure there is no residue left on it and that the connector is not scratched or damaged.

6.2 Diagnostic of dysfunctions

AROONA-STAR is a passive equipment and rarely experiences technical failures.

If you detect some unusual losses in the system, follow the instructions for cleaning LC/PC connectors of the affected channel.

If the problem persists, make sure there is no bending constraint at the AROONA-STAR output multimode fiber (bending radius must be higher than 2 cm).

If excessive losses are still being detected, the splice quality between the AROONA-STAR output fiber and the deployed fiber is likely at issue. In this situation, it is advised that a new splice between both fibers is performed.

Intermediate connector replacement splices may also be involved. A reflectometry measurement can assist you in identifying the problematical splice.

If these various steps have been taken and additional losses still persist, please feel free to contact CAILabs' technical support.

6.3 Safety

When the transceiver is connected, optical emissions from the connector output or from the AROONA-STAR output fiber are produced by a laser source and could be hazardous to the eyes (laser class 1/1M).

Unless there isn't any light source at the opposite end of the fiber, do not look directly at the optical cable core. An optical power meter can be used to ensure that there is no light inside the fiber.

It is extremely important to respect the safety rules.

In addition, fibers themselves present certain serious risks as they are composed of glass and can easily break. Be careful during splicing operations that no glass tiny fragments get into your skin, causing irritations. Wash your hands after handling the bare fiber before putting them in contact with eyes.

Do not open or dismantle AROONA-STAR equipment. The modal adapter is bounded to its box and must be contained within the box. Any opening or dismantling could damage AROONA-STAR equipment and void the warranty.

Handle AROONA-STAR equipment carefully. Do not shake the rack. Do not pull or bend AROONA-STAR input and output fibers.

All instructions concerning technical data in this guide are valid when the equipment is used according to recommended conditions of use.

CAILabs



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