ANDREW®

ION™–B Series

User Manual

rel. 24–10

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Index

1. Introducing ION-B

1. Introducing ION-B

1.1 The Features

ION-B is an innovative platform designed in order to provide an effective and flexible coverage to a large variety of indoor scenarios.
Thanks to its high modularity, its low power consumption, and its full-transparency to protocols and modulation formats, ION-B is the perfect plug&play solution to distribute any wireless standard (including GSM, GPRS, EDGE, CDMA, W-CDMA, and WLAN IEEE 802.11b/g) to the in-building environments requiring reliable and interference-free communications, as well as high traffic capacity and maximum flexibility about future expansions.
These unique features make the ION-B platform suitable also for applications to critical areas experiencing difficulties in establishing and keeping phone calls, while its compact design always guarantees a minimum aesthetic impact.

1.2 Brief Description of ION-B

ION-B is a Distributed Antenna System (DAS) based on the Radio-over-Fibre (RoF) technology, and capable of carrying wireless mobile signals through the 800MHz - 2500MHz frequency range regardless of their protocol and their modulation format.
The system has two basic components, a Master Unit and a Remote Unit. The Master Unit is made of one or more subracks typically connected to the BTS (Base Tranceiver Station) through either a repeater (RF interface) or a coaxial cable.
Each Remote Unit is connected with a dedicated pair of single-mode optical fibres (one for UL and one for DL) to the Master Unit. These optical fibres work on 1310 nm wavelenght and provide low losses and almost unlimited bandwidth, available for future system developments.
ION-B is a modular system whose basic components are:

- one Master Unit made of one or more subracks, each providing 12 module slots. Each slot can host either an active or a RF passive device (chosen among the wide range of ION-B options), in order to meet the planned design requirements;

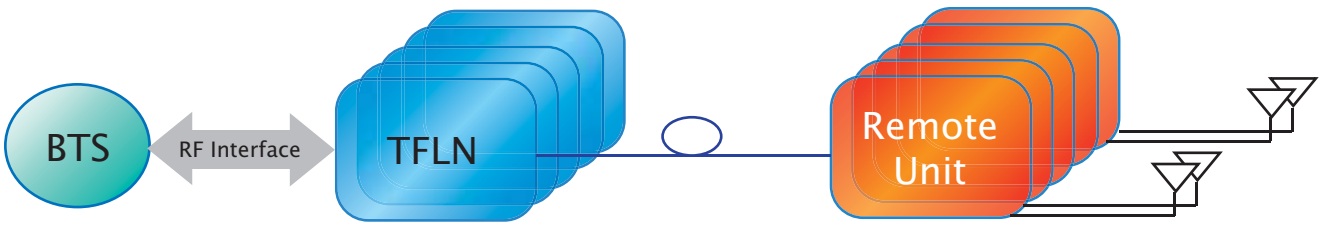


Figure 1: *ION-B system block diagram*

- a variable number of Remote Units (TFAx), whose function is feeding the antenna passive network;
- a proper number of indoor antennas, suitable to provide radio coverage to the area. ION-B is fully compatible with any type of indoor antennas;
- the optical cables required to connect the 19" subracks to the TFAx.

1.3 ION-B Features

The following lines report a brief summary of ION-B main features:

- multiband 2G, 2.5G and 3G – 802.11b WLAN compatible: ION-B is completely transparent to any transmission protocol and modulation format, and it can distribute any 2G, 2.5G, 3G wireless standard. In addition, it allows to carry also the WLAN (802.11b/g) service over the same infrastructure;
- modular configuration for flexible design: by properly setting some parameters like the amount of RUs and the antenna locations, the ION-B architecture can follow the environment specific features in order to obtain the most effective radio-coverage of the indoor area. The modularity of the system allows easy modifications for future growth and increasing traffic;
- easy to install: the intelligent plug & play ION-B system includes an Automatic Gain Control (AGC), that eliminates system gain variations regardless of optical loss. This avoids the need for field adjustments, thus reducing design, installation and optimization time.
- low-power consumption: establishing a "quasi line-of-sight propagation" towards all mobile phones inside the area, ION-B works with low power levels. Low power levels have two great advantages: 1) allow mobile phones to work at lower power levels, thus limiting the radiated emissions and increasing their battery life; 2) allow a better control of interference effects between adiacent cells.
- central supervision functions: all individual alarms of ION-B system are stored in an internal flash memory, and available to both local and remote connections. Detailed alarm information is provided by special software (i.e. by Supervision or Maintenance software tools) running on a locally connected host, as well as any information about alarm status and alarm history is available to remote connections via TCP/IP protocols, SNMP agent, or HTTP servers. This alarm information is visible also by means of LEDs present on the front panels of both the MU and the RUs;
- multiple-carriers system: there are no restrictions on the number of carriers that the ION-B can convey. Obviously, the more carriers per service, the less power per carrier;
- remote power supply: in case mains cannot be used for the Remote Units, ION-B offers a centralised power supply option, which distributes both a DC low-voltage (-48V) power and the optical signals through a composite fibre optic/copper cable;
- wide variety of RF passive devices: the connections between the DAS and the local BTSs are able to be arranged so as to get the best fit for the customers needs. ION-

B equipment provides RF splitters/combiners, cross band couplers, attenuators, and duplexers for UL/DL paths, thus allowing maximum in design flexibility;

- high reliability: high MTBF (Mean Time Between Failure).

1.4 ION-B Typical Applications

Due to its unique features, the ION-B is an ideal solution for radio coverage in a variety of situations:

- Multi-operator shared infrastructures: each mobile operator has its own carrier which needs to be transported without interfering the others. The ION-B is capable of transmitting multiple carriers simultaneously while providing independent level adjustments for each of them, ensuring maximum performance and reducing infrastructure costs.
- High rise buildings: RF signals from surrounding macrocells or external BTSs are usually quite strong inside high rise buildings and can cause so much interference that indoor mobile communications often become impossible. By strategically placing antennas along the exterior walls of the building, the signal to noise ratio can be optimised. This interference control solves many problems, such as the "ping pong" effect that sometimes is experienced when a mobile frequently changes from indoor to outdoor coverage.
- Exhibitions, conventions, and shopping centres: the critical aspect of these environments is their high traffic loads, which are furthermore also highly variable. Thus, the main goal in these cases is to set up radio coverage enabling the effective management of these variable traffic loads, with neither undervalued nor overvalued infrastructure expenses. A unique feature of the ION-B is that RF frequencies can be allocated quickly when and where they are needed, thus reducing implementation costs. This makes the ION-B an ideal solution for temporary or last minute requests (such as conferences).
- Airports: require both modular and flexible radio coverage in order to meet their current needs while also foreseeing future expansions. The ION-B is able to manage heavy traffic loads, providing a high level of quality with minimum environmental impacts, its modularity also allows for future expansions.
- Corporate buildings: inside a corporate building, frequent disruptions during mobile communications may limit business transactions. These environments are often complex and densely populated while having specific requirements: heavy traffic capacity, high expectations regarding quality of service, full compatibility with wireless standards and future expandability. The ION-B guarantees high quality radio coverage in all of the above conditions and maintains maximum flexibility while managing any possible traffic conditions.
- Subways and densely populated metropolitan areas: These areas are distinguished by large surface areas, and may require RUs to be placed far away from the BTSs. The ION-B guarantees signal integrity for distances up to 3km, while through the

wideband interconnect link option, distances of 20km can be reached. Moreover, these environments require gradual investments, because initially operators tend to provide radio coverage only in the busiest areas, and then extend it in order to reach complete coverage later. The modularity of the ION-B helps operators to gradually expand the system. Often, large cities set up seamless and reliable radio systems for emergency services. In these cases, the required RF infrastructure needs to be unobstrusive and environmental friendly; this can be achieved using an ION-B DAS. When redundancy is required, two interleaved ION-B systems can be used, management and supervision for these systems can be remotely established by means of an external modem and an open protocol such as SNMP.

2. Equipment Overview

2. Equipment Overview

2.1 Introduction

The basic components of an ION-B system (please refer to fig. 2.1.) are the following:

- a Master Unit, able to bring the mobile signals from the BTS to different Remote Units and vice-versa, thus remotising the distribution and collection of any mobile signals via fiberoptic cables;
- a variable number of Remote Units, conveying and receiving mobile signals through low-power antennas.

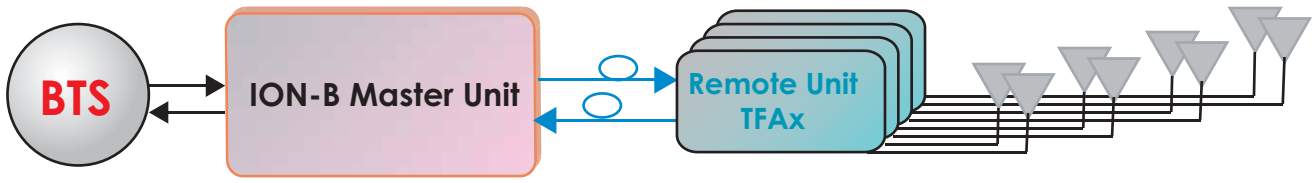


Fig. 2.1: Basic scheme of an ION-B system

A brief introduction to the main components of the ION-B system's Master and Remote Units is presented in the following text. The details of each component can be found in the subsequent sections of this manual.

2.2. The ION-B Remote Unit and its relevant accessories

Fig. 2.2:
Different versions of the ION-B Remote Units:
(a) Case-A Remote Unit
(b) Case-B Remote Unit;
(c) Case -R Remote Unit;
(d) Case-R2 Remote Unit;
(e) Case-F Remote Unit

The Remote Unit (TFAx) is a device which provides optical-to-electrical downlink conversion and electrical-o-optical uplink conversion, thus allowing a bidirectional transmission of signals between the Master Unit and the remote antennas. It is available in 3 different power configurations (Low/Medium/High), housed by 4 different architectures (Case B, Case R, Case R2 and Case F), so as to fulfil different coverage and band requirements.

In downlink, each TFAx receives an optical signal from the Master Unit, performs an optical-to-RF conversion, and transmits the resulting signal to the 2 antenna ports.
In uplink, it receives an RF signal from the remote antennas, provides an RF-to-optical conversion, and conveys the converted signal to the Master Unit through optical fibres.
The ION_B Remote Units are available both with power supply 90÷264 Vac and with power supply -72÷-36 Vdc. Each ION-B Remote Unit is provided with a suitable external power adapter (TPSNx: please refer to table 2.1).
Last, each ION-B Remote Unit has a wideband auxiliary channel, which can be exploited for dedicated RF distribution.

Remote UnitS and accessories		
Unit name/ Module name	**Description**	**Dimensions (L x W x H)**
TFAx-case A	Remote Unit	200 x 240 x 38 (mm)
TFAx Case B	Remote Unit	240 x 240 x 38 (mm)
TFAx Case R	Remote Unit	330 x 200 x 122.5 (mm)
TFAx Case R2	Remote Unit	330 x 250 x 122.5 (mm)
TFAx Case F	Remote Unit	546 x 253 x 207 (mm)
TFBWx	WLAN booster	240 x 200 x 38 (mm)
TKA04	Remote Unit installation kit	340 x 240 x 55 (mm)
TPSN 1-40	External power supply	175 x 80 x 54 (mm)
TPSN 1-80	External power supply	
TPSN 3-30	External power supply	175 x 80 x 51 (mm)
TPSN 3-80	External power supply	

Table 2.1: Different cases of ION-B Remote Units, with dedicated ION-B accessories.

2.3. The ION-B Master Unit

The ION-B Master Unit is a widely-flexible system. Its modular feature allows it to be developed both for simple installation-friendly, unobstrusive applications to complex installations, involving a virtually unlimited number of subracks, and distributed through several floors of a building or through a 20km distance.
The following text presents a brief overview of the components of these units.

The TPRF31 Fast MiniRack is a 19" x 1HE fast-MiniRack housing 2 slots: it can therefore accommodate 2 of the single-slots (7TE x 4HE) ION-B cards presented in the following. Thanks to its turnable brackets, the TPRF31 is suitable both for wall and rack-mounting, and can therefore be used both as a stand-alone unit (for simple ION-B installations) and as an integration of a bigger and more complex ION-B system .

Fig. 2.3 TPRF31 subrack

The TPRN sub-rack is a 19"x 4HE subrack with 12 slots, each one sized 7TE x 4HE. As each ION-B module takes up one or two slots, each Master Unit can host up to 12 modules, depending on the design configuration and requirements.

Fig. 2.4 TPRN subrack

The Master Optical TRX (TFLN): in downlink, it provides an RF-to-optical conversion of the signal coming from the BTS, and transmits it to 4 optical outputs, so as to feed 4 TFAx. In uplink, it provides optical-to-RF conversion for 4 optical signals coming from the RUs, and it combines them into a single RF output, while providing automatic gain control in order to balance the fibre losses. Module dimensions:
Width = 7TE, Height = 4HE (one slot in the master unit sub-rack).

Fig. 2.5 TFLN card

The Duplexer (TDPN): it combines the downlink (DL) and the uplink (UL) paths into a single one, while maintaining the required isolation. The module dimensions are: Width = 7TE, Height = 4HE

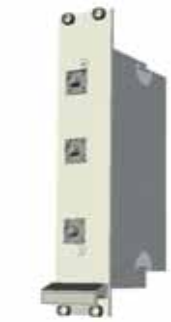


Fig. 2.6 TDPN card

The variable RF attenuators (TBSI): they provide independent attenuations (adjustable from 0 to 30dB, with 1dB steps) on uplink and downlink RF paths, and allow the designer to optimize the signal level close to the BTSs. TBSI is an override attenuator, its dimensions are: Width = 7TE, Height = 4HE.

Fig. 2.7 TBSI card

The Dual Band Coupler (TLDN): in downlink, it combines a low band RF signal (800 to 1000 MHz) and a high band RF signal (1700 to 2500 MHz) into a common RF port; in uplink, it splits a composite signal between a low band RF port and a high band RF port. Module dimensions are: Width = 7 TE, Height = 4 HE.

Fig. 2.8 TLDN card

The Tri Band Coupler (TLTN): in downlink, it combines a Low Band signal, a Middle Band signal, and a High Band signal into a communal one; in uplink, it splits the triple band signal among the three RF single band paths.
Please refer to table 4.7.1 or to the bulletin PA-100596-EN for further information about the different band configurations.
Module dimensions are: Width = 7 TE, Height = 4 HE.

Fig. 2.9 TLTN card

The RF splitters/combiners (TLCN2 and TLCN4): TLCN2 is a 2-way splitter/combiner. TLCN4 is a 4-way splitter/combiner. They can be used in a variety of different situations, such as:

- To connect a BTS with several master optical TRXs. In uplink, the TLCN2 (or TLCN4) combines 2 (or 4) RF signals which come from different master optical TRXs into a common RF signal entering the BTS. In downlink, the TLCN2 (or TLCN4) splits the downlink composite RF signal which comes from the BTS into 2 (or 4) RF ports, entering different master optical TRXs.

(a) *(b)*

Fig. 2.10 TLCN2 (a) and TLCN4 (b) cards

• To connect several BTSs to a master optical TRX. In downlink, the TLCN2 (or TLCN4) combines the RF signals coming from different BTSs into a common RF signal, entering the master optical TRX. In uplink, the TLCN2 (or TLCN4) splits the composite RF signal coming from a master optical TRX into 2 (or 4) RF signals entering different BTSs.

The Power Limiter (TMPx-10): it monitors the DL power coming from the BTS and attenuates it by 10 dB in case it surpasses a programmable threshold level.
The TMP2-10 Power Limiter is for 2G and 2.5G signals, working at 900 MHz and 1800 MHz.
The TMP3-10 Power Limiter is for 3G signals.
Both modules are 7TE wide and 4HE high.

Fig. 2.11 TMPx-10 card

Table 2.2 shows an overview of the basic components of the ION-B Master Unit.

Basic components of ION-B Master Units		
Unit name/ Module name	**Description**	**Dimensions, H x W (x D)**
TPRF31	Fast MiniRack	19" x 1HE x 286mm
TPRN04	Passive subrack	19" x 4HE x 350mm
TPRNx4	Active subrack	19" x 4HE
TFLNx	Master Optical TRX	7TE x 4HE
TLCN 2	2-way splitter	7TE x 4HE
TLCN 4	4-way splitter	7TE x 4HE
TBSI 2-30	Adjustable attenuator	7TE x 4HE
TDPNx	UL/DL duplexer	7TE x 4HE
TLDNx	Dual band coupler	7TE x 4HE
TLTNx	Tri band coupler	7TE x 4HE
TMPx-10	10 dB power limiter	7TE x 4HE

Table 2.2: Overview of the components and accessories for the ION-B master unit

2.4. ION-B additional options

The basic ION-B structure described above can be furtherly expanded or supported by a range of ION-B options, including:

- A supervision unit (TSUN), enabling to supervise and manage the ION-B system through any PC or Laptop, thanks to a web-interface supporting the TCP/IP, FTP, HTTP, protocols, and fully compatible with general purpose SNMP managers.
- RF boosters, which can be connected to the auxiliary channels of the ION-B Remote Units, thus providing RF coverage in some particular frequency bands (e.g. AWS 1700 MHz in US, Wi-Fi, or Wi-Max);
- A wide range of Interconnect Link options (TIL), i.e. a set of master-slave modules which enable to expand the ION-B system through additional subrack stations, up to 20 km away from the main one.
- A Remote Powering Unit (TRSN), providing -48Vdc power supplying through composite fiberoptic/copper cables

Table 2.3 shows an overview of these ION-B accessories and of the corresponding Andrew bulletins you should refer to for further information.

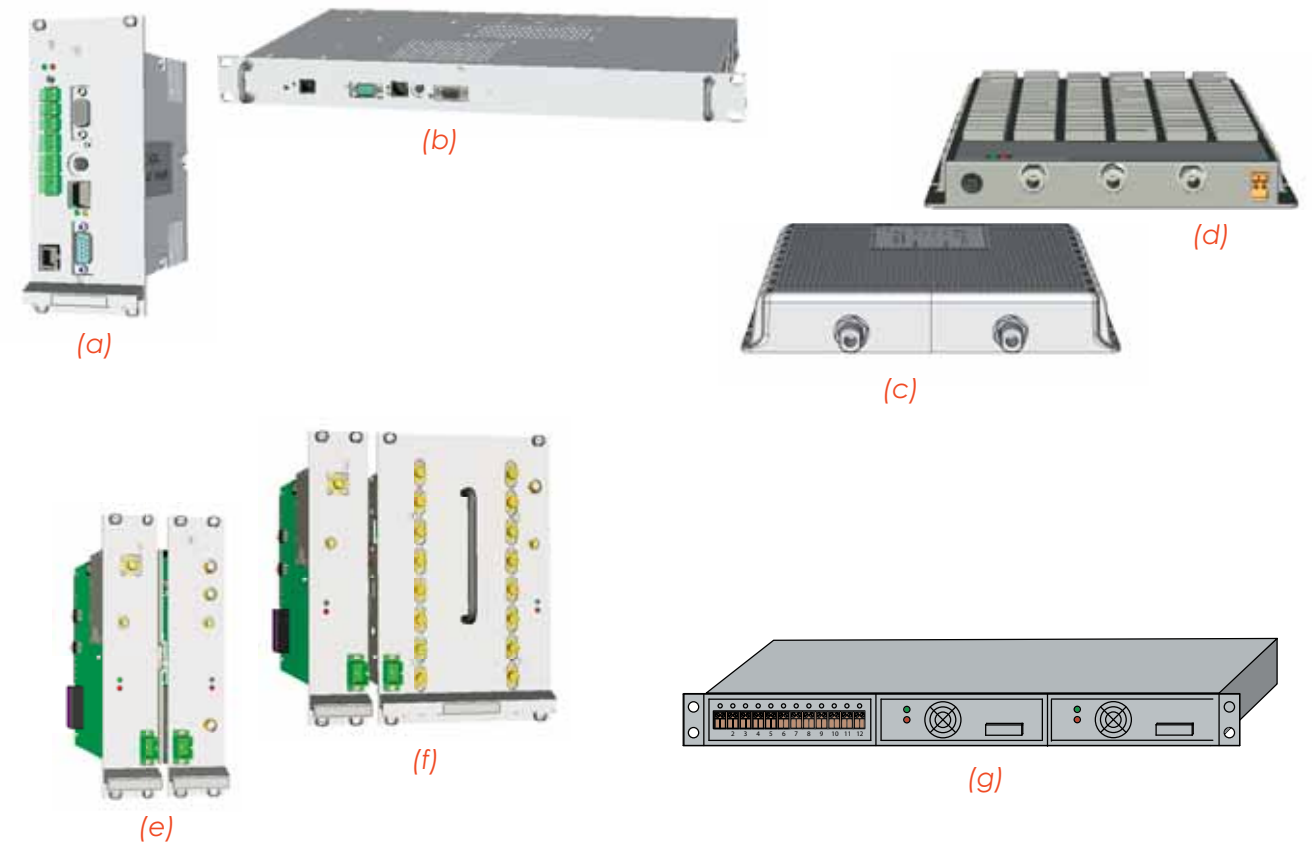


Fig. 2.12: TSUN supervision unit, available both as a plug-in card (a) and as a stand-alone module (b) ; Wi-Fi (c) and (AWS 1700 MHz) boosters; Interconnect-link master modules (e) and slave modules (f); TRSN Remote Powering units (g)

Although the following table tables show a brief overview of the main ION-B additional options, we strongly recommend you to contact your reference Andrew Salesperson or Product Line Manager in order to have For a full overview of the ION-B options,

Main ION-B additional options			
Unit name/ Module name	**Reference Bulletin**	**Reference Manual**	**Mechanical Decription**
ION-B Supervision Unit (TSUN 1, 3, 6)	PA-100596-EN	MN023	Available both as a plug-in card and as a stand-alone unit
ION-B Wi-Fi options	PA-100928-EN	MN031	Different solutions available
TIL Interconnect link	BR-102130-EN	MN032	multi-module master side + multi-module slave side (each one made of a variable number of plug-in cards)
RF dedicated booster	PA-102073-EN		stand alone unit, 240 x 200 x 38 mm
TRSN Remote Power Units	PA-102072-EN	MN033	19" x 3HE (low power version) 19" x 1HE (medium power version)

Table 2.3: Overview of the components and accessories for the ION-B rack-based master unit

2.5. Block Diagrams

In order to better understand the functionalities of the different units and modules, some block diagrams of the ION-B system are presented here.

The core of an ION-B system is the ION-B master unit, which generally develops through a passive section (providing Level adjustments, Signal splitting/combining, and Band coupling), followed by an Electrical/Optical conversion (allowing the signal to be distributed through fiberoptic cables to the TFAx Remote Units).

Simple and unobstrusive ION-B installations can be developed through the TPRF31 fast MiniRacks, which allows a great deal of installation solutions, such as:
- hosting two electrical/optical transceivers, while developing external passive combining
- hosting one electrical/optical transceiver, plus one ION-B interface card (providing splitting/combining , band coupling or level adjusting).

Please note that more TPRF31 modules can be combined to achieve a more complex, space-saving system configuration.
Tipical ION-B configurations based on a single TPRF31 Fast MiniRack are shown in fig. 2-13.

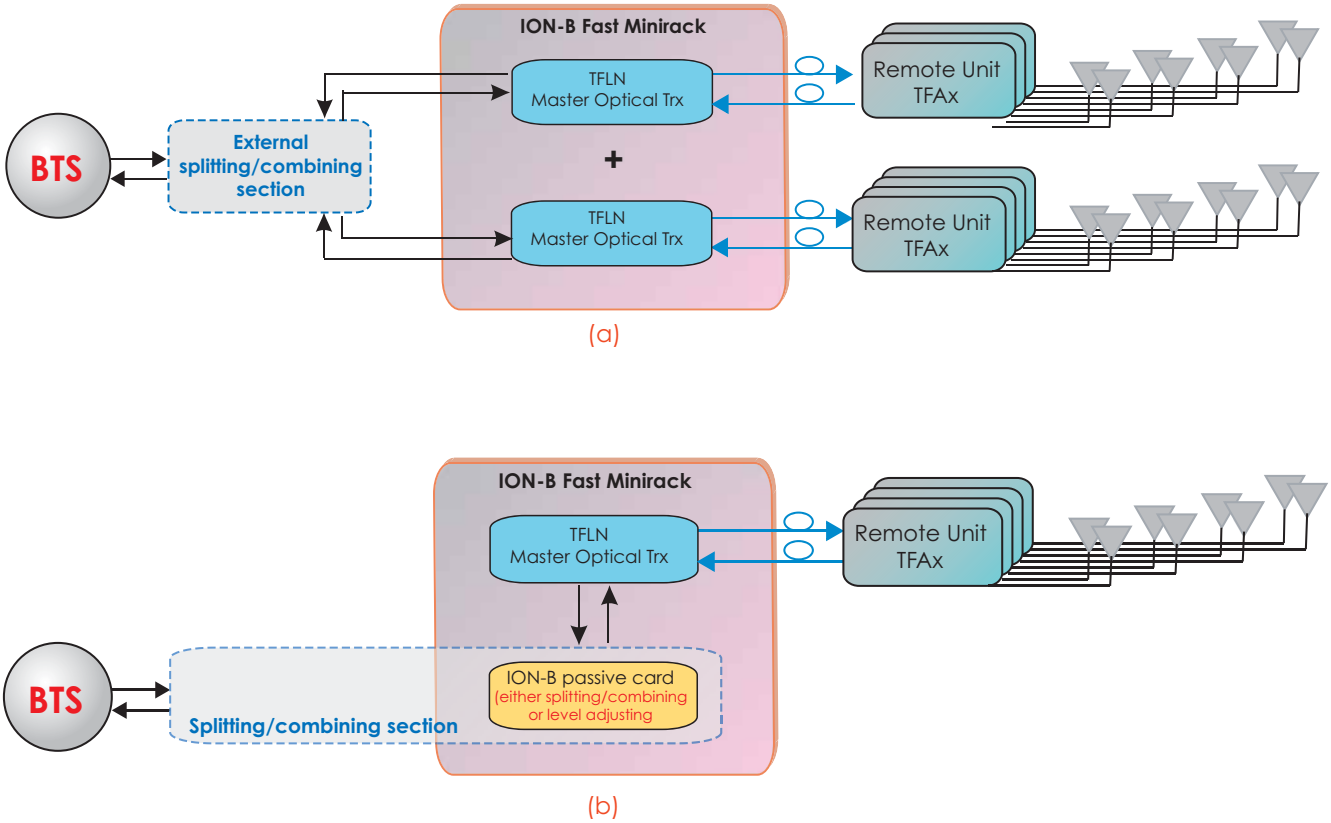


Fig. 2.13: ION-B configurations based on a TPRF31 Fast MiniRack: (a) Configuration hosting 2 TFLN optical transceivers; (b) Configuration hosting 1 TFLN optical transceiver and 1 splitting/combining card

Although TPRF31 proves to be very flexible, complex distribution systems usually can be better served by rack-based ION-B Master Units: such ION-B installations are based on one or more TPRN-subracks, thus exploiting the wide range of ION-B passive cards (TDPN, TMP, TBSI, TLCN2, TLCN4, TLTN, TLDN), in order to build the passive network which best matches the costumer's needs.
Let's see some examples of such rack-based configurations.
Firstly, assume that the BTSs are not duplexed. In this case, no TDPN module (see fig. 2.14) is required. Moreover, assuming that the Master Unit is made up of one or more subracks located in a single site, we do not need an interconnect link in order to remotise a second subrack. The scheme of this network configuration is reported hereafter in figure 2.14.

Now let's consider the same network configuration, but with duplexed BTSs. In this case, some TDPN modules (see fig. 2.7) are required in order to combine UL and DL ports on single RF channels. The scheme of this network configuration is reported hereafter in figure 2.15.

If we need to expand our ION-B network to a wider area, please note that the Interconnect-link option allows you to use a second subrack station at a distance of up to 20km from the site where the main subrack station is located.
Please refer to the dedicated Interconnect link brochure (Table 2.3) for further details.

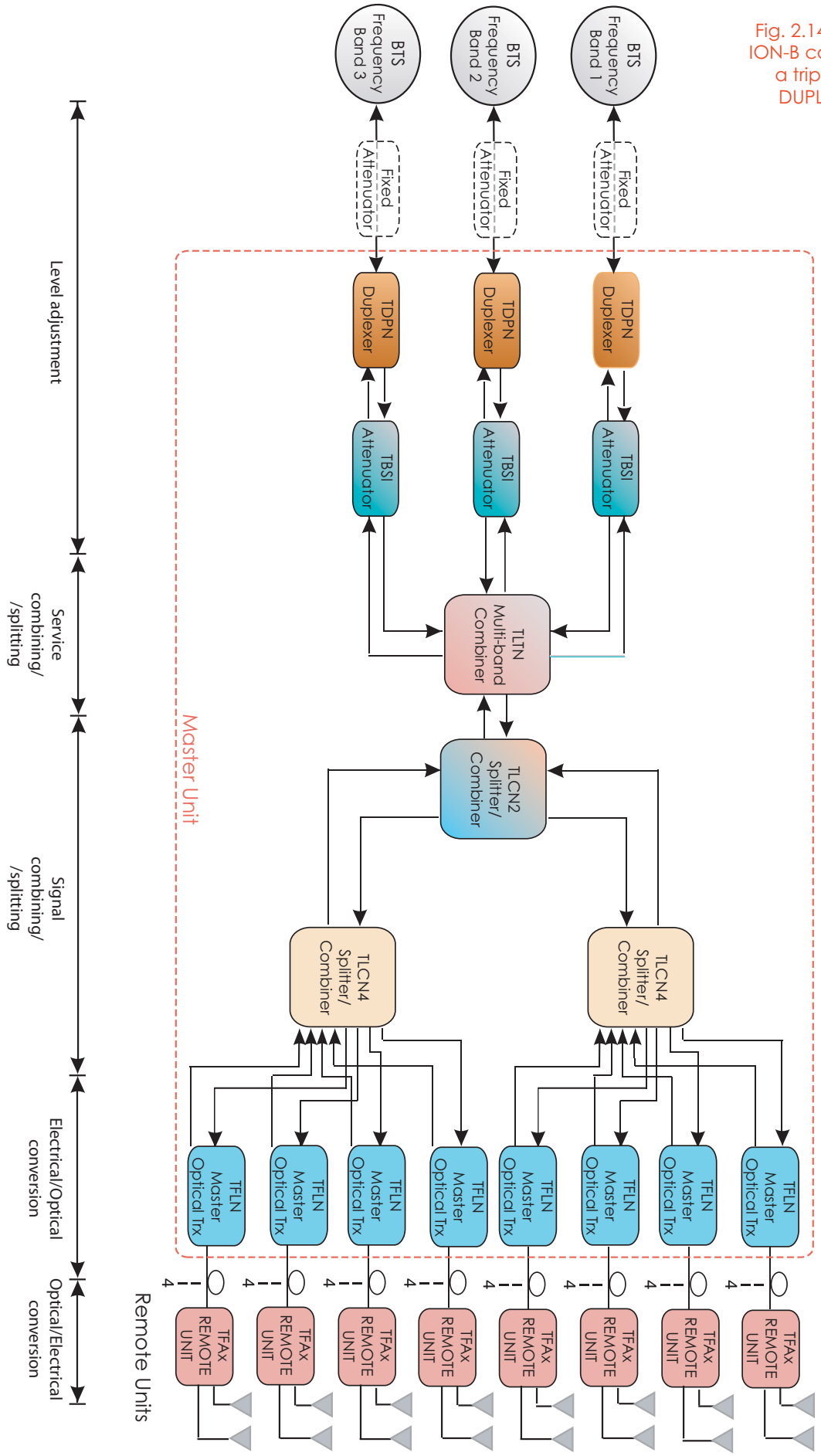


Fig. 2.14: Block diagram of an ION-B configuration supporting a triple-band system with DUPLEXED base stations.

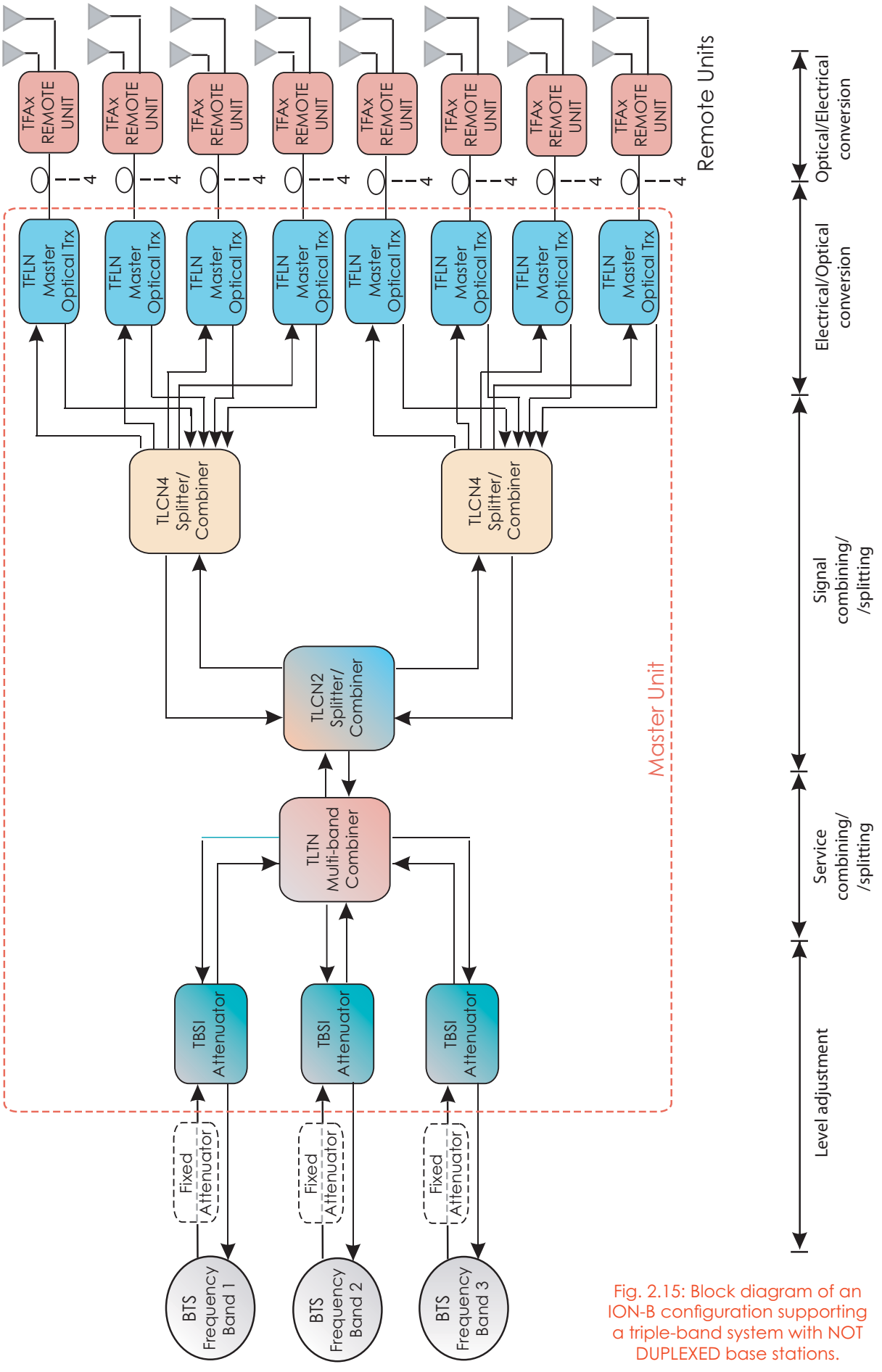


Fig. 2.15: Block diagram of an ION-B configuration supporting a triple-band system with NOT DUPLEXED base stations.

3. TFAx Remote Unit

3.1. Introduction

The Main Tasks of the TFAx Unit:

Downlink (DL):

- Optical-to-RF conversion of the input optical signal
- Automatic Gain Control (AGC) of each converted signal, in order to compensate optical losses;
- RF amplification: the converted RF signal is boosted in order to maintain a good signal-to-noise ratio
- RF filtering: a proper filter rejects the spurious emissions
- RF duplexing and splitting: the boosted RF signal is conveyed to 2 antenna ports

Fig. 3.1.1: ION-B Remote Units: different cases for different solutions

Uplink (UL):

- RF amplification: a low noise amplifier boosts the signal received from antennas in order to maintain a good signal-to-noise ratio
- RF filtering: the boosted signal is cleaned of the spurious emissions

- Automatic Level Control (ALC): the RF signal level is adjusted according to blocking requirements
- RF-to-optical conversion of the signal, which is finally conveyed to the output optical port

Different Types of Remote Units

In order to allow radio coverage with different power and band requirements, the ION-B architecture provides a wide variety of Remote Units. This allows the customer to choose the solution which best fits its coverage and environmental demands.

Depending on the bands where the radio coverage has to be provided and on the signal power required to cover the environment, your Remote Unit will fall into one of the topologies shown in figure 3.1.1.

The following 4 sections of the manual refer to these 4 Remote Unit topologies. Please follow the instructions described in the section corresponding to the case (A, B, R, R2, F) of your particular Remote Unit.
The case of your Remote Unit can be easily identified in Figure 3.1: or, as an alternative, you could contact your Sales representative or check it on the official ION-B Brochure (see fig. 3.1.2),.
As in fig. 3.1.2, the "TFAM 91/18/20" Remote Unit proves to be described in the Andrew bulletin PA-100508-EN. Look through the Remote Unit's dedicated bulletin in order to get all of the technical specifications concerning the unit itself.

Remote UnitS

Power Class*, dBm								Case	Product Code	Bulletin Code	
GSM900	EGSM900	GSM1800	UMTS2100	LMR800	Cellular850	LMR900	AWS1700	PCS1900	PCS1900 Ext.		
27	-	-	27	-	-	-	-	-	-	B	TFAM 90/20	PA-100582-EN
-	27	-	27	-	-	-	-	-	-	B	TFAM 91/20	PA-100583-EN
-	-	27	27	-	-	-	-	-	-	B	TFAM 18/20	PA-100584-EN
-	32	32	36	-	-	-	-	-	-	R2	TFAM91/18/20	PA-101508-EN
-	-	-	-	27	-	-	-	27	-	B	TFAM 80/19	PA-100801-EN
-	-	-	-	-	27	-	-	27	-	B	TFAM 85/19	PA-100805-EN
-	-	-	-	-	-	-	27	27	-	B	TFAM 17/19	PA-101848-EN
-	-	27	-	-	27	-	-	-	-	B	TFAM 85/18	PA-100808-EN
-	-	-	27	-	27	-	-	-	-	B	TFAM85/20	PA-100809-EN
-	-	-	-	21	-	21	-	-	27	B	TFAM80/92/19E	PA-101058-EN

Fig. 3.1.2: Remote Unit description in the official ION-B Brochure (Rev. 03/07)

3.3. Case A Remote Unit

Dimensions and Weight:

Dimensions: 38 x 240 x 200 mm
(1.5 x 9.4 x 7.9 inches)

Weight : please refer to the Remote Unit dedicated bulletin in order to discover any updated data regarding the weight of the case A Remote Unit

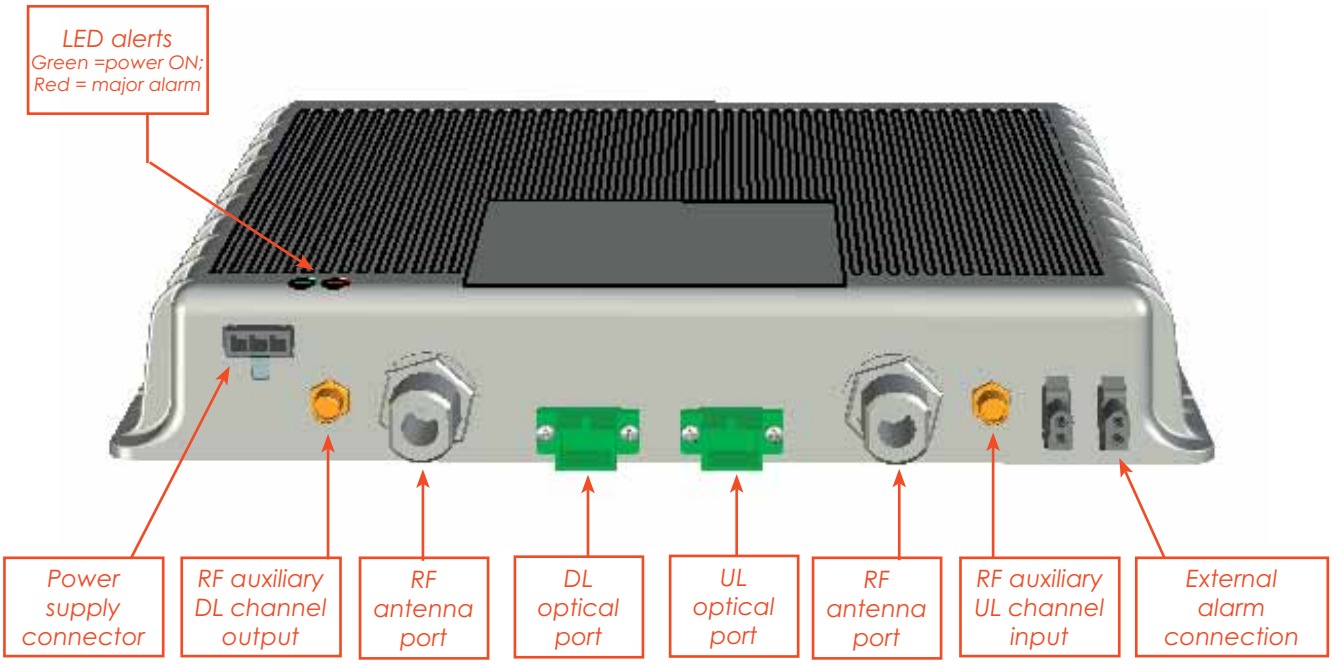


Fig. 3.2.1: TFAx Case A Remote Unit

RF ports:

- 2 RF antenna ports, transmitting/receiving signals to/from distributed antennas. RF antenna ports are duplexed N-female connectors. These RF ports can be connected to the antennas either directly (ie. through RF jumper cables) or through splitters, thus allowing more antennas to be fed. Unused RF ports have to be terminated with a 50 Ω load.
- 1 RF auxiliary input and 1 auxiliary output (designed to receive and transmit additional signals). Auxiliary input and output ports are SMA-female connectors.

Optical ports:

- 1 optical output port, transmitting UL signals to TFLN master optical TRX
- 1 optical input port, receiving DL signals from TFLN master optical TRX

Visual Alarms:

Two control LEDs are provided on the TFAx front side (Fig. 3.2.2). The green LED indicates the power supply status, while the red LED indicates any major Remote Unit failures (please refer to Table 3.4).

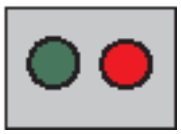


Figure 3.2.2 - LED alarms on the upper-front side of Case B Remote Units (including Power version)

Led colour	Meaning
Red	Low optical power at DL input and/or RF amplifier failure
Green	Power supply OK

Table 3.2.1 - Description of the LEDs of Case-A remote unts

Dry Contact Alarms:

TFAx is provided with two dry contact inputs which can be connected (through .062" MOLEX plugs) to any external device. The alarm information regarding this external device is able to be signalled through the red LED of the TFAx LED panel and displayed on the Supervision System in this way.

Figure 3.2.3:
Dry contacts for external alarms

Power Supply

The *Case A* Remote Unit is provided with a TPSN external power supply (Fig. 3.2.4 a,b), available either for universal mains (90 to 264) or for negative supply. (-72 to -36 Vdc).

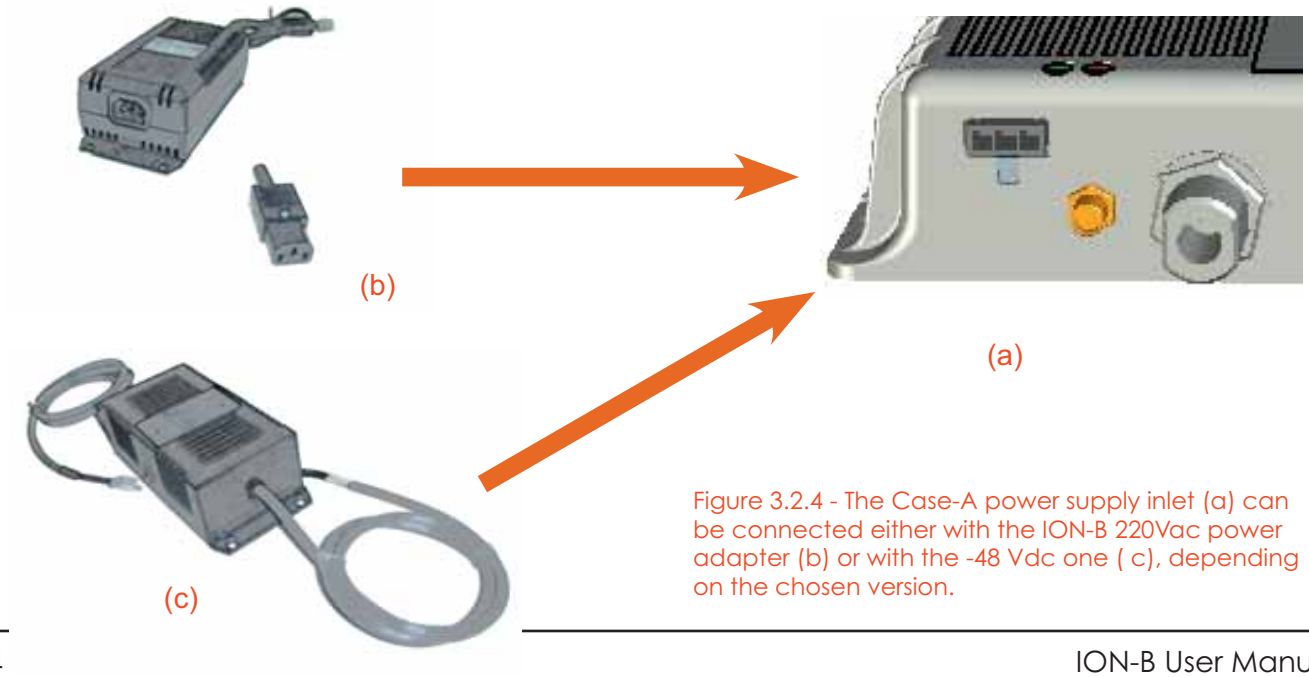


Figure 3.2.4 - The Case-A power supply inlet (a) can be connected either with the ION-B 220Vac power adapter (b) or with the -48 Vdc one (c), depending on the chosen version.

TPSN external power supplies provide the *Case A* Remote Unit with +5Vdc power, by means of a 3-pole connector.

Warnings (to be read before Remote Units are installed)

Dealing with optical output ports

The TFAx Remote Unit contains semiconductor lasers. Invisible laser beams may be emitted from the optical output ports. Do not look towards the optical ports while equipment is switched on.

Choosing a proper installation site for the Remote Units

- TFAx Remote Units have to be installed as close as possible to the radiating antennas, in order to minimize coaxial cable length, thus reducing downlink power loss and uplink noise figures.
- When positioning the TFAx Remote Unit, be sure to place related antennas in such a way as to minimize the Minimum Coupling Loss (MLC), in order to avoid blocking.
- The TFAx Remote Unit is intended to be fixed on walls, false ceilings or other flat vertical surfaces (TKA installation kits are available, they provide a protective cover for the TFAx Remote Unit, while making installation easier and faster).

Handling optical connections

- When inserting an optical connector, take care to handle it so that the optical fibre is not damaged. Optical fibres are to be in single-mode (SM) 9.5/125µm.
- Typically, ION-B equipment is provided with SC-APC optical connectors (other connectors are provided upon request). Inserting any other connectors will result in severe damage.
- Do not force or stretch the fibre pigtail with curvature radius of less than 5cm. See figure on right for optimal fibre cabling.
- Remove the adapter caps only just before making connections. Do not leave any SC-

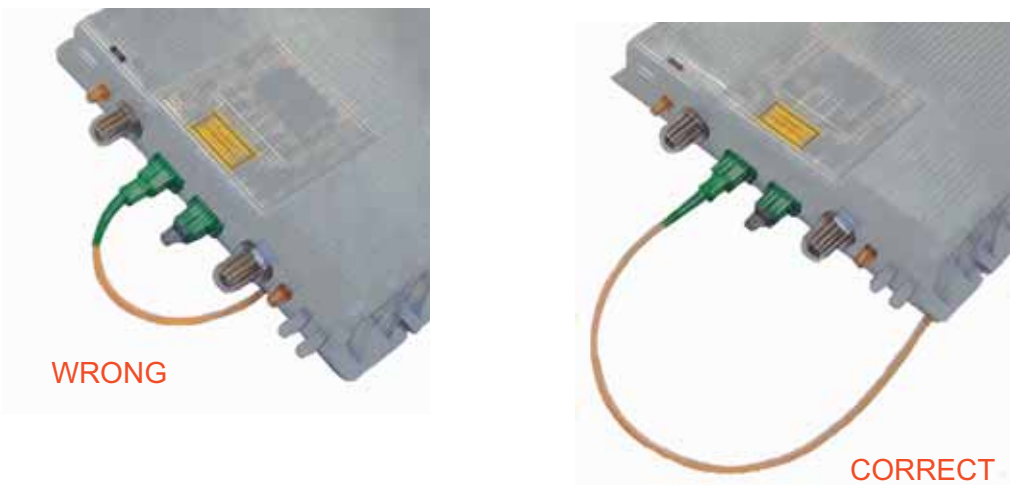


Figure 3.2.5 - Handling optical connections with ION-B Remote Units.

APC adapters open, as they attract dirt. Unused optical connectors must always be covered with their caps.

- Do not touch the connector tip. Clean it with suitable material before inserting each connector into its sleeve. If connector tips require cleaning, use only pure ethyl alcohol.

TFAx Case A installation

The Case B Remote Unit is able to be fixed to walls, false ceilings or other flat vertical surfaces, either directly or through a TKA04 installation kit (optional).

Installing a Case A Remote Unit WITHOUT the TKA kit

The TFAx kit includes:

1. a Remote Unit TFAx
2. a TPSN external power supply adapter (86 to 264 Vac or -72 to -36 Vdc, according to the chosen model)
3. a VDE connector or a -48 Vdc plug (according to the chosen model)

The TKA04 kit includes:

A. four screw anchors (fixing the wall bearing to the wall)
B. five screw anchors (fixing the TFAx Case A to the wall bearing)
C. a wall mounting box (wall bearing + cover)
D. a splice holder

Please consider these guidelines in order to choose the correct positioning of the Remote Unit and of its power supply:

- Under no circumstances should any piece of equipment be affected by the heat

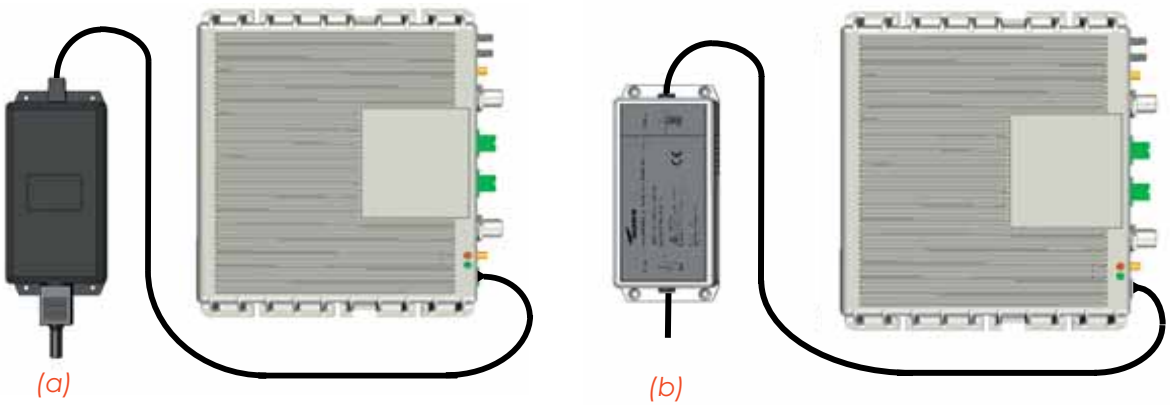


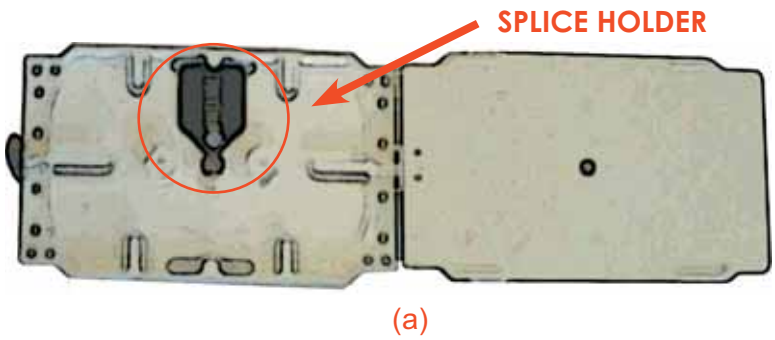
Figure 3.2.6: Example of proper mounting configuration, which assures proper heat dissipation. Note that the Remote Unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The Figures refer to a 90/264 vac TFAx Case A (an) and to a -36/-72 Vdc TFAx Case A (b).

created by any other piece. The Remote Unit and its external power supply should be mounted so as to avoid reciprocal heating. Side-by-side configuration is suggested (Fig. 3.2.6 a,b)

- Remote Units are provided with cooling fins which allow the optimization of heat dissipation. In order for them to function properly, the mounting environment should allow for the necessary air changeover
- It is strongly recommended not to mount the external power supply on a horizontal surface because this position does not allow heat dissipation. External power supplies must be mounted on vertical surfaces.
- In order to assure proper heat dissipation, external power supplies must be mounted in a vertical position with the power socket downwards (see Fig. 3.2.7 a,b).

Once you have chosen a location for the Remote Unit, please follow these instructions:

1. In order to install the M4 screw anchors (not included) which hold up the TFAx Remote Unit, drill into the wall according to the proper layout shown in Fig. 3.2.9.
2. Fix the TFAx to the wall by firmly tightening the screws into the anchors.
3. In order to install the M4 screw anchors (not included) which hold up the power supply



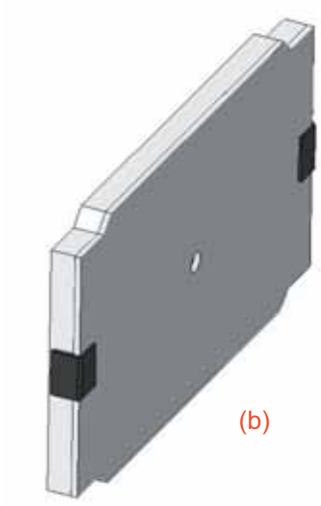


Fig. 3.2.7. (a) inside of the Splice Tray, with the Splice Holder positioned properly; closed splice tray (b)

external adapter, drill into the wall according to the proper layout of your power supply, shown in fig.3.3.10b

4. Fix the external power supply adapter to the wall by firmly tightening the screw into the anchors.
5. Fix the splice holder inside the splice tray (not included) See Fig. 3.2.7 a,b.
6. Splice the optical fibres and close the splice tray. While handling the fibers, be careful not to bend them.
7. Fix the splice tray beside the Remote Unit.
8. Connect the external adapter to the TFAx Remote Unit with the proper cable.
9. If the Remote Unit is -48 Vdc powered, use the -48 Vdc plug (included) in order to

connect the external adapter to the -48 Vdc supply (Fig. 3.2.6 b). If the Remote Unit is 90/264 Vac-powered, fix the 90/264 Vac plug (included) onto a power cord (not included), and use this cable to connect the external adapter to the mains (Fig. 3.2.6 a).

10. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors.
11. Once the installation is finished, please follow the section "TFAx Case A Start-up" in order to carry out a proper system start up.

Installation of the Case A Remote Unit WITH the TKA04 installation kit

The TFAx Case A kit includes:

1. a Remote Unit TFAx
2. a 50 Ω load
3. a TPSN external power supply adapter (86 to 264 Vac or -72 to -36 Vdc, according to the chosen model)
4. a VDE connector or a -48 Vdc plug (according to the chosen model)

The TKA04 kit includes:

A. four screw anchors (fixing the wall bearing to the wall)
B. five screw anchors (fixing the TFAx Case A to the wall bearing)
C. a wall mounting box (wall bearing + cover)
D. a splice holder

Please consider these guidelines carefully in order to decide the proper positioning of the

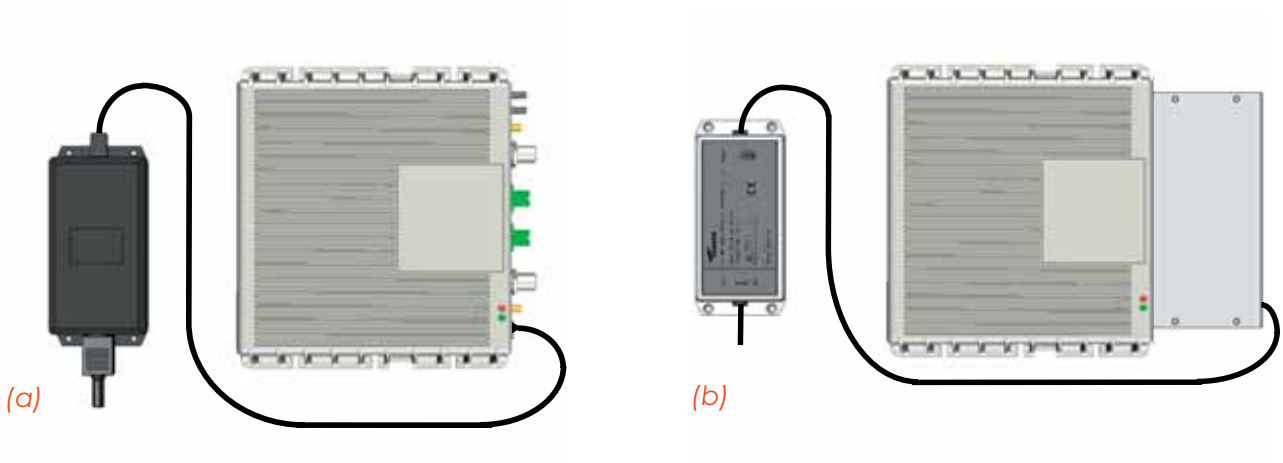


Figure 3.2.8:
Example of proper mounting configuration, which assures proper heat dissipation. Note that the Remote Unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The Figures refer to a 90/264 vac TFAx Case A (a) and to a -36/-72 Vdc TFAx Case A (b), respectively.

Remote Unit and its power supply:

- Under no circumstances should any piece of equipment be affected by the heat created by any other piece. The Remote Unit and its external power supply should be mounted so as to avoid reciprocal heating. Side-by-side configuration is suggested (Fig. 3.2.8 a,b)
- It is strongly recommended not to mount the external power supply on a horizontal surface because this position does not allow for heat dissipation. External power supplies must be mounted on vertical surfaces.
- In order to assure proper heat dissipation, the external power supplies must be mounted in a vertical position with the power socket downwards (see Fig. 3.2.8 a,b).

Once you have chosen the position of the Remote Unit mounting case, please follow these instructions:

1. Unscrew the 4 screws which lock the lower cover of the TKA04 wall bearing (see Fig. 3.2.12 a)
2. In order to install the M4 screw anchors (included) which hold up the TKA04 wall bearing, drill into the wall according to the TKA layout shown in Fig. 3.2.11.
3. Fix the TKA04 wall bearing by firmly tightening the screws into the anchors.
4. In order to install the M4 screw anchors (not included) which hold up the power supply external adapter, drill into the wall according to the power supply layout shown in Fig.3.3.10 b.
5. Fix the external power supply adapter to the wall by firmly tightening the screws into the anchors (Fig. 3.2.13 b).
6. Carefully open the splice tray by using a screwdriver as in Fig. 3.2.12 c. Fix the splice holder inside the splice tray (Fig. 3.2.6 a). Splice the optical fibres and close the splice tray. While handling the fibers, take care not to bend them. Close the splice tray.
7. Fix the Remote Unit to the wall-bearing by using the included screws (Fig. 3.2.6 b).
8. If the Remote Unit is -48 Vdc powered, use the -48 Vdc plug (included) in order to connect the external adapter to the -48 Vdc mains (Fig. 3.2.8 b). If the Remote Unit is 90/264 Vac-powered, fix the 90/264 Vac plug (included) onto a power cord (not included), and use this cable in order to connect the external adapter to the mains (Fig. 3.2.8 a).
9. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors (Fig. 3.2.12 e). If the power cable has properly been connected to the mains, both the green and the red LEDs should turn on. The green LED will remain lit to indicate that the unit is powered on, while the red LED will turn off as soon as the local unit is switched on (for further details about the start up of the system, please refer to the section "TFAx Case A Start-up")
10. Fix the lower cover by fastening the 4 screws (Fig. 3.2.12 f)

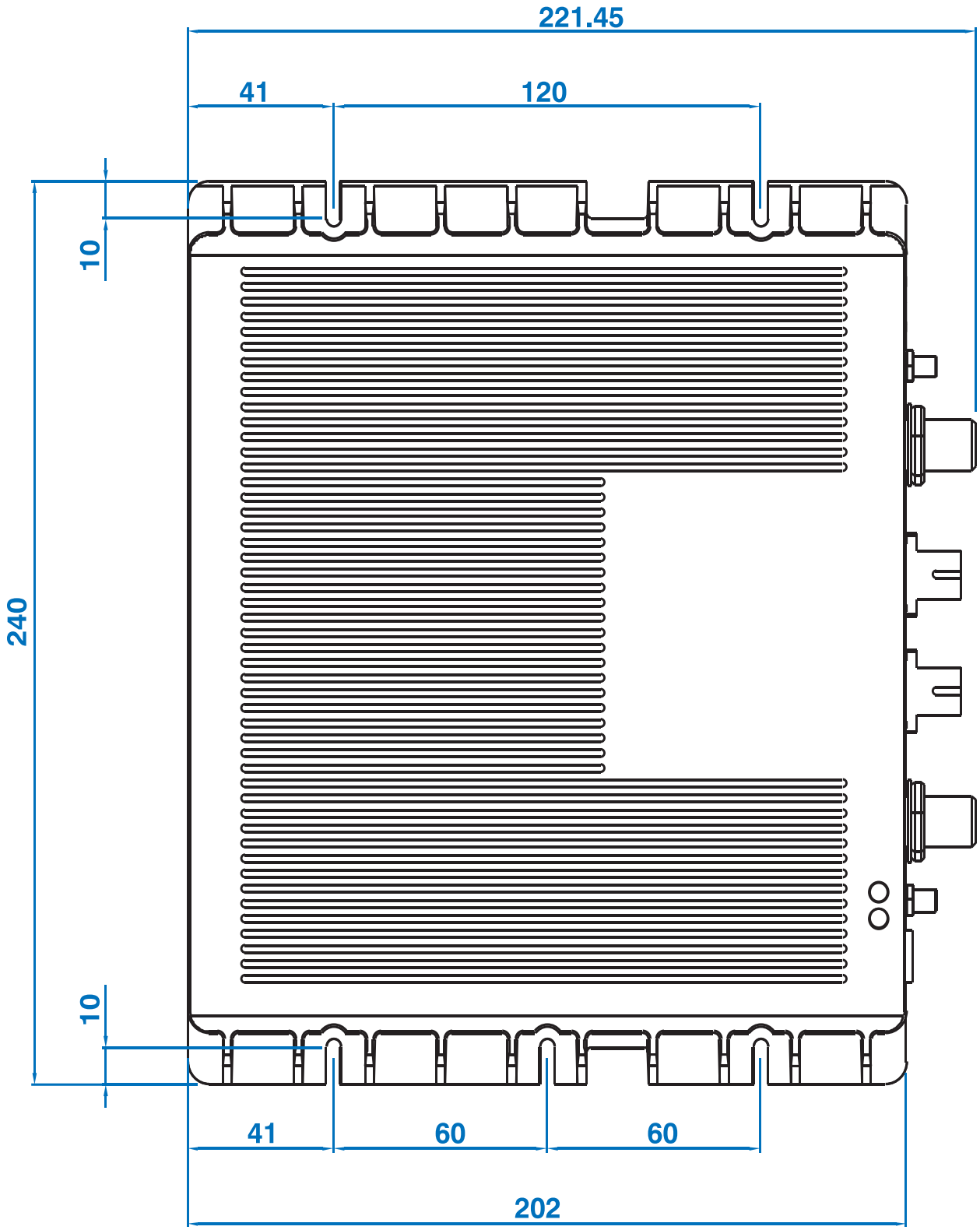


Figure 3.2.9 : Case A layout with waal anchor quotes

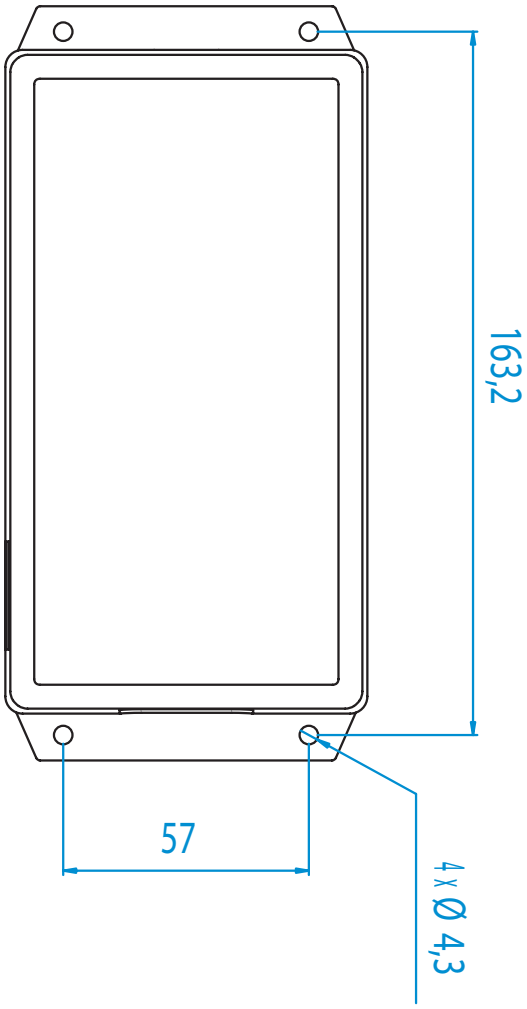


Figure 3.2.10:
Layout of the 220Vac/+5Vdc power adapter, provided with Case A Remote Units.

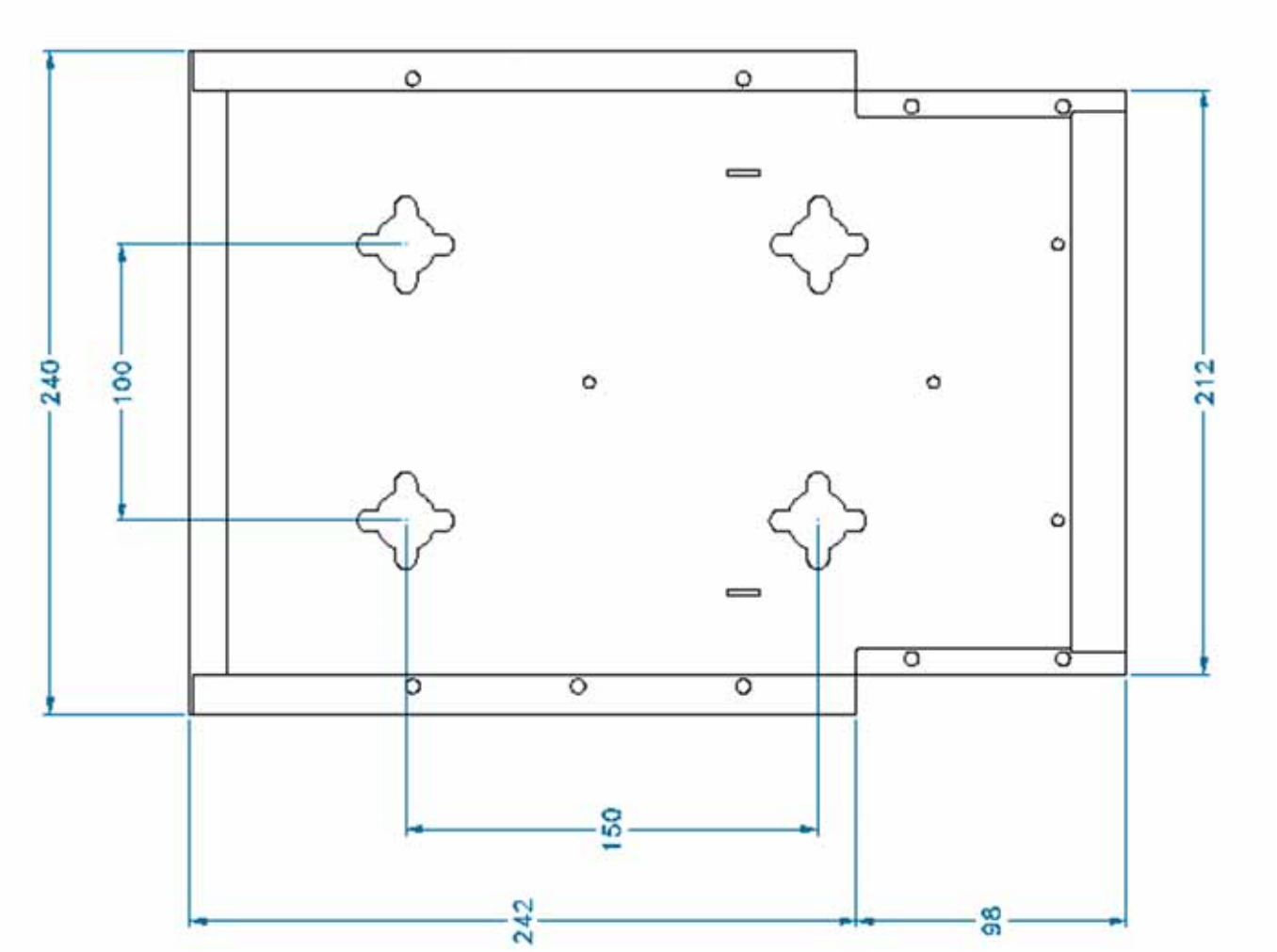


Figure 3.2.11: Layout of the TKA installation kit for TFAx Remote Unit, Case A.

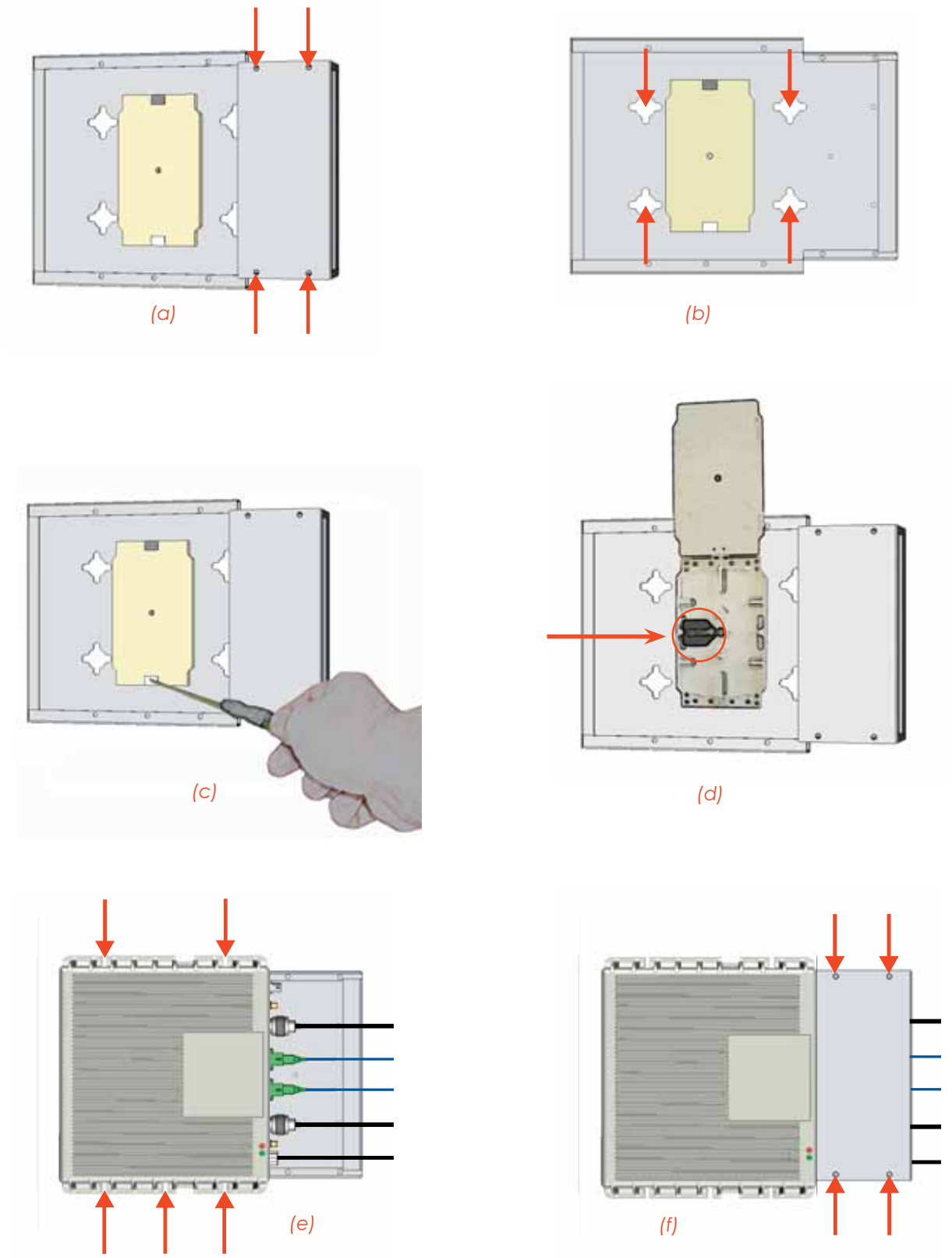


Figure 3.2.12: Mounting the TFAx Case A Remote Unit with a TKA installation kit.
Please not that the Figures do not show the mounting of the external power supply.adapter.

TFAx Case A Start-Up

Before the TFAx Remote Unit is switched on, make sure that:

- the modules hosted in the master unit have been connected to each other with RF jumpers, according to the system design
- every TFLN master optical TRX has been connected to its Remote Units
- each Remote Unit has been connected to its coverage antennas

For a correct system start-up, all the Remote Units have to be switched on prior to the master unit.

Once the TFAx has been switched on, its behaviour can be summarized as per the following indicators:

1. When the Remote Unit is turned on, both the LEDs upon the warm side turn on for a couple of seconds
2. After that, the unit's green LED remains on (thus indicating proper power supply), while the red LED switches off as soon as the master unit is turned on (meaning that DL optical power is OK and no alarms are present).
3. Once the master unit has been switched on, the status of both LEDs should be those indicated in Table 3.2.1. In case the red LED remains on, please refer to the Troubleshooting section.
4. After being switched on, the Remote Unit should start up correctly and in order to be recognized by the supervision management system, the corresponding TFLN master optical TRX should carry out the discovery phase (please refer to the Supervision System Manual for more details). During this phase, which can last for up to a max. 4min, depending on the system complexity, the TFLN LED ⌐┘ blinks. Do not connect/disconnect any cables or pieces of equipment during the discovery phase! This may result in the identification failure of the Remote Unit.

Note: in case discovery doesn't start automatically, check through either the LMT or the remote supervision for whether it has been disabled (refer to LMT or remote Supervision System manuals for further information).

TFAx Case A Troubleshooting

Please refer to the ***TFAx Case A and Case B troubleshooting*** for a full overview of the troubleshooting procedures for Case A Remote Units.

3.4. Case B Remote Unit

Dimensions and Weight:

Dimensions: 38 x 240 x 240 mm
(1.5 x 9.4 x 9.4 inches)

Weight : please refer to the Remote Unit dedicated bulletin in order to discover any updated data regarding the weight of the Case B Remote Unit

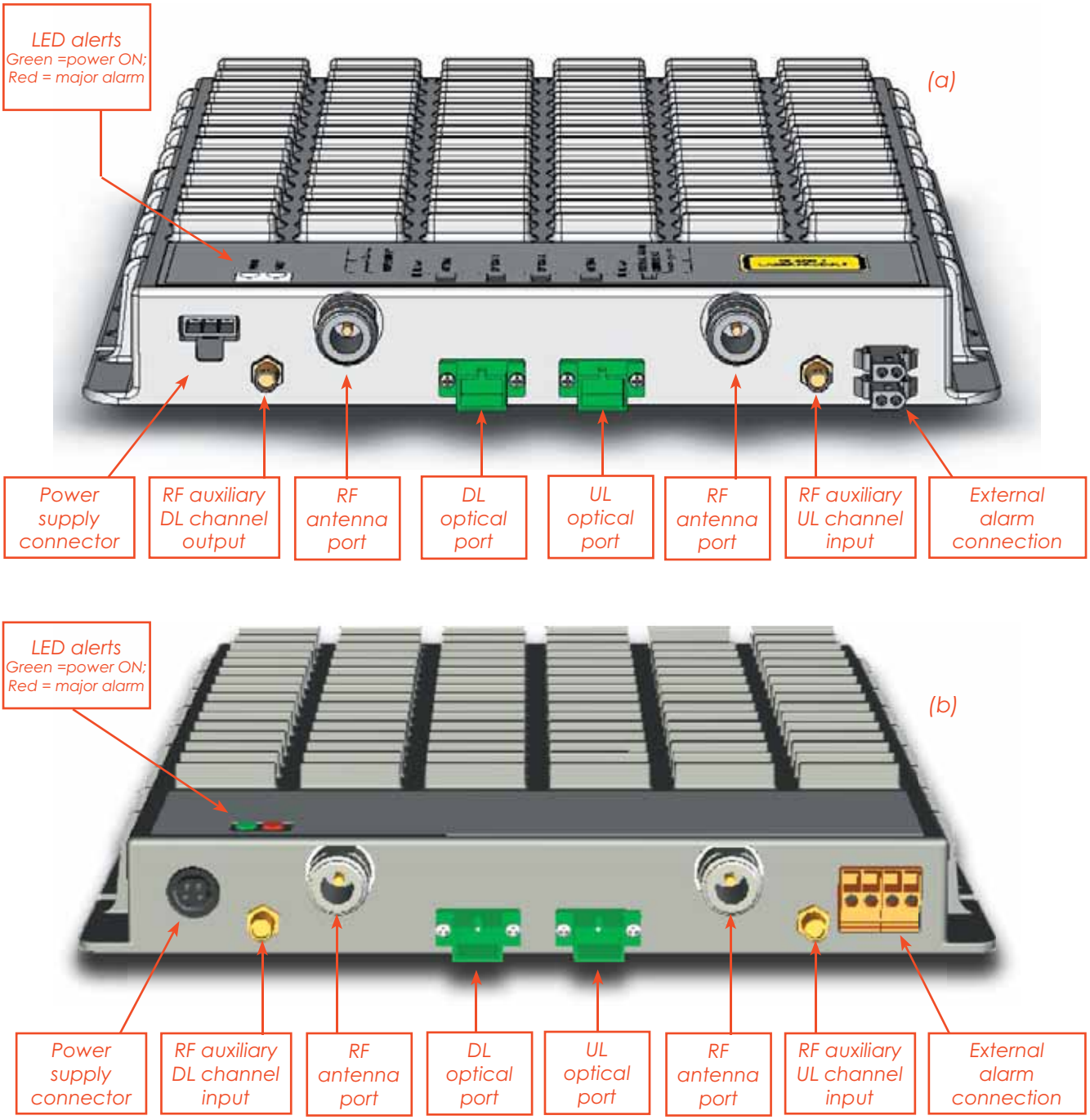


Fig. 3.3.1: TFAx Case B Remote Unit (a) and TFAx Case B Remote Unit, Power version (b)

RF ports:

- 2 RF antenna ports, transmitting/receiving signals to/from distributed antennas. RF antenna ports are duplexed N-female connectors. These RF ports can be connected to the antennas either directly (ie. through RF jumper cables) or through splitters, thus allowing more antennas to be fed. Unused RF ports have to be terminated with a 50 Ω load.
- 1 RF auxiliary input and 1 auxiliary output (designed to receive and transmit additional signals). Auxiliary input and output ports are SMA-female connectors.

Optical ports:

- 1 optical output port, transmitting UL signals to TFLN master optical TRX
- 1 optical input port, receiving DL signals from TFLN master optical TRX

Visual Alarms:

Two control LEDs are provided on the TFAx front side (Fig. 3.3.2). The green LED indicates the power supply status, while the red LED indicates any major Remote Unit failures (please refer to Table 3.4).

Figure 3.3.2 - LED alarms on the upper-front side of Case B Remote Units (including Power version)

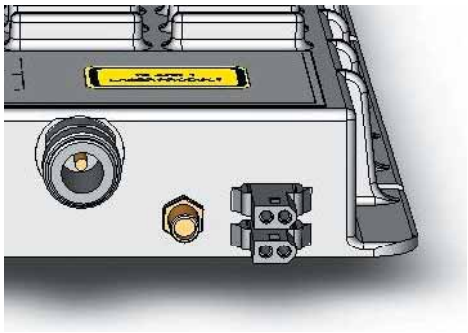
Led colour	Meaning
Red	Low optical power at DL input and/or RF amplifier failure
Green	Power supply OK

Table 3.3.1 - Description of the LEDs of Case-B remote unts

Dry Contact Alarms:

TFAx is provided with two dry contact inputs which can be connected (through .062" MOLEX plugs) to any external device. The alarm information regarding this external device is able to be signalled through the red LED of the TFAx LED panel and displayed on the Supervision System in this way.

(a)



(b)

Figure 3.3.3 - Dry contacts for external alarms on (a) Case B Remote Unit and (b) case-B Power Remote Unit

Power Supply

The *Case B* and *Case B, Power version* Remote Units are provided with different types of TPSN external power supplies (Fig. 3.3.4 a,b), available either for universal mains (90 to 264) or for negative supply. (-72 to -36 Vdc).
TPSN external power supplies for *Case-B* Remote Units provide the with +5Vdc power, by means of a 3-pole connector (Fig. 3.20 c).
TPSN external power supplies for *Case-B, Power version* Remote Units provide the with +28Vdc power, by means of a shielded circular connector (Fig. 3.20 c).
Before installing your Remote Unit, please check you have been provided with the proper external power supply. Should you have any doubt, please contact your Sales representative.

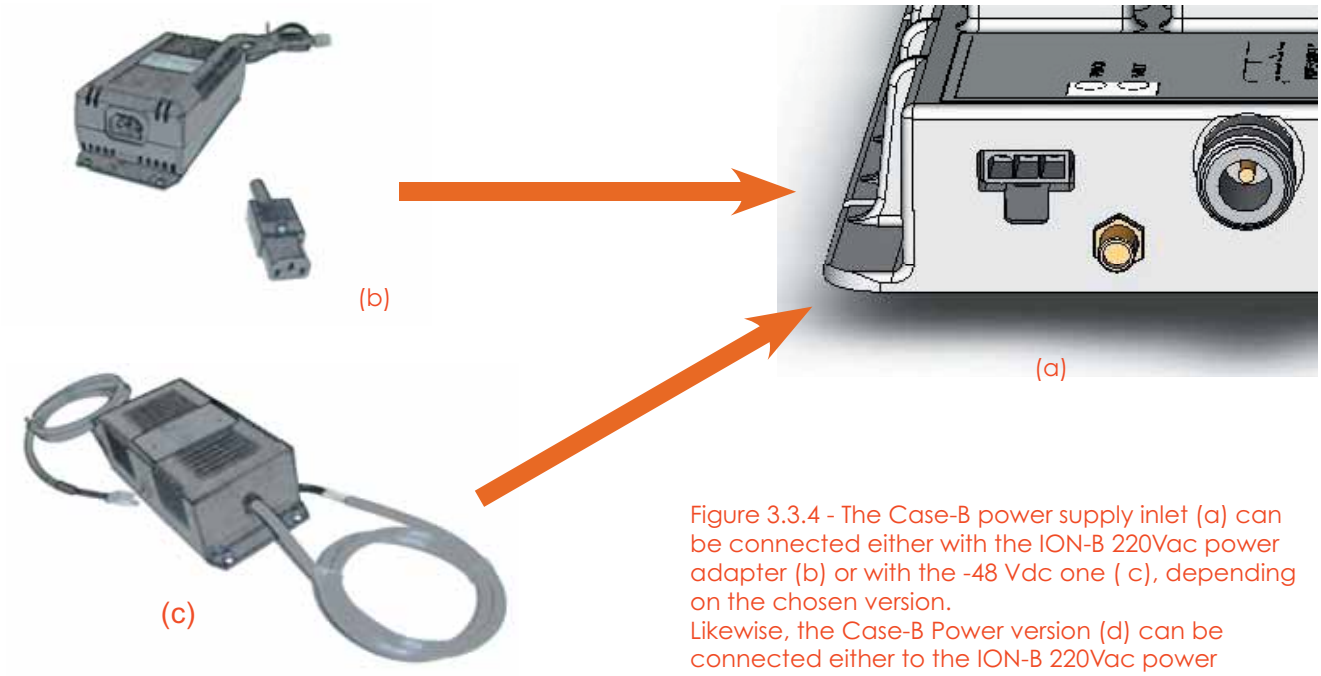
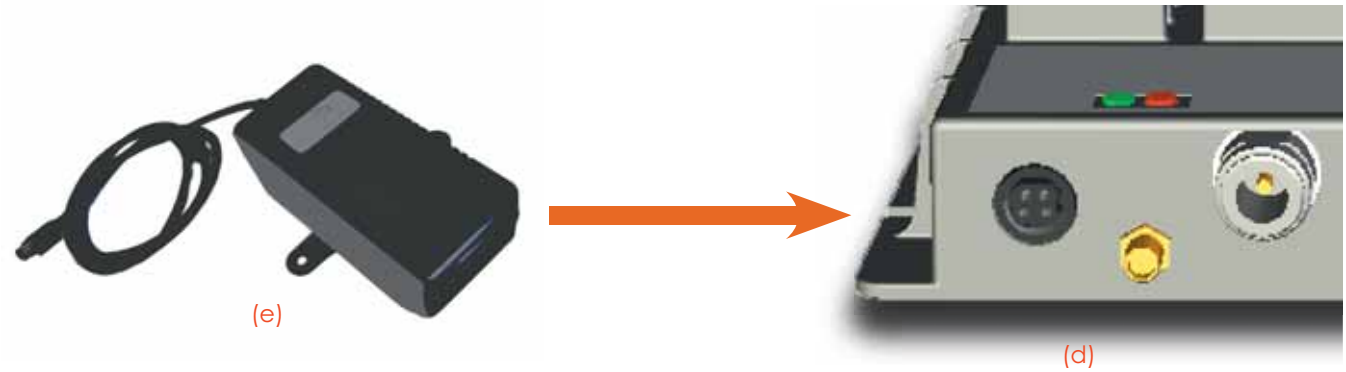


Figure 3.3.4 - The Case-B power supply inlet (a) can be connected either with the ION-B 220Vac power adapter (b) or with the -48 Vdc one (c), depending on the chosen version.
Likewise, the Case-B Power version (d) can be connected either to the ION-B 220Vac power adapter or to the -48Vdc one (e).



Warnings (to be read before Remote Units are installed)

Dealing with optical output ports

The TFAx Remote Unit contains semiconductor lasers. Invisible laser beams may be emitted from the optical output ports. Do not look towards the optical ports while equipment is switched on.

Choosing a proper installation site for the Remote Units

- TFAx Remote Units have to be installed as close as possible to the radiating antennas, in order to minimize coaxial cable length, thus reducing downlink power loss and uplink noise figures.
- When positioning the TFAx Remote Unit, be sure to place related antennas in such a way as to minimize the Minimum Coupling Loss (MLC), in order to avoid blocking.
- The TFAx Remote Unit is intended to be fixed on walls, false ceilings or other flat vertical surfaces (TKA installation kits are available, they provide a protective cover for the TFAx Remote Unit, while making installation easier and faster).

Handling optical connections

- When inserting an optical connector, take care to handle it so that the optical fibre is not damaged. Optical fibres are to be in single-mode (SM) 9.5/125µm.
- Typically, ION-B equipment is provided with SC-APC optical connectors (other connectors are provided upon request). Inserting any other connectors will result in severe damage.
- Do not force or stretch the fibre pigtail with curvature radius of less than 5cm. See figure on right for optimal fibre cabling.
- Remove the adapter caps only just before making connections. Do not leave any SC-APC adapters open, as they attract dirt. Unused optical connectors must always be covered with their caps.

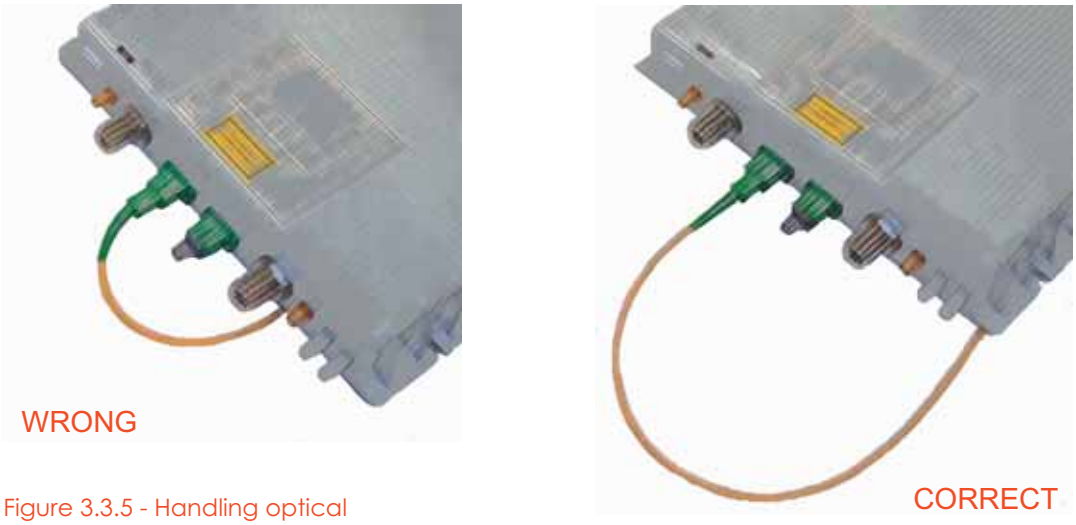


Figure 3.3.5 - Handling optical connections with ION-B Remote Units.

- Do not touch the connector tip. Clean it with suitable material before inserting each connector into its sleeve. If connector tips require cleaning, use only pure ethyl alcohol.

TFAx Case B installation

The Case B Remote Unit is able to be fixed to walls, false ceilings or other flat vertical surfaces, either directly or through a TKA04 installation kit (optional).

Installing a Case B Remote Unit WITHOUT the TKA kit

The TFAx kit includes:

1. a Remote Unit TFAx
2. a TPSN external power supply adapter (86 to 264 Vac or -72 to -36 Vdc, according to the chosen model)
3. a VDE connector or a -48 Vdc plug (according to the chosen model)

The TKA04 kit includes:

A. four screw anchors (fixing the wall bearing to the wall)
B. five screw anchors (fixing the TFAx Case B to the wall bearing)
C. a wall mounting box (wall bearing + cover)
D. a splice holder

Please consider these guidelines in order to choose the correct positioning of the Remote Unit and of its power supply:

- Under no circumstances should any piece of equipment be affected by the heat created by any other piece. The Remote Unit and its external power supply should be mounted so as to avoid reciprocal heating. Side-by-side configuration is suggested (Fig. 3.3.6 a,b)

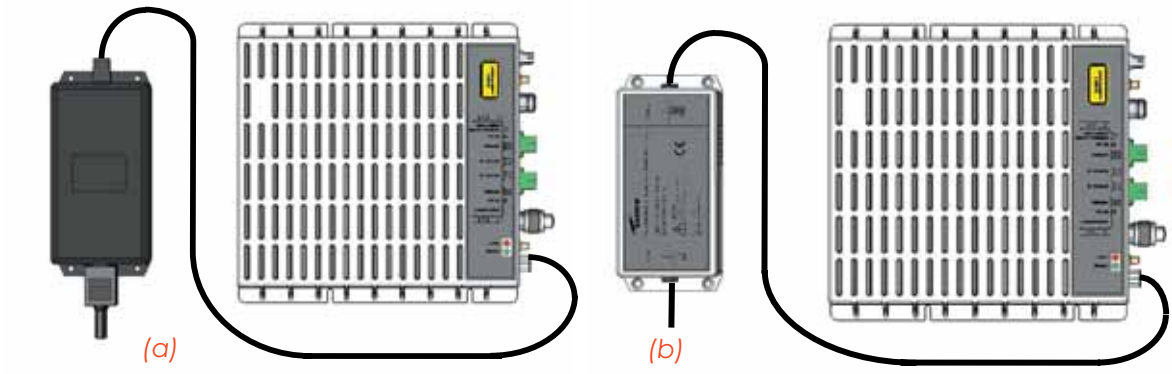


Figure 3.3.6: Example of proper mounting configuration, which assures proper heat dissipation. Note that the Remote Unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The Figures refer to a 90/264 vac TFAx Case B (an) and to a -36/-72 Vdc TFAx Case B (b).

- Remote Units are provided with cooling fins which allow the optimization of heat dissipation. In order for them to function properly, the mounting environment should allow for the necessary air changeover
- It is strongly recommended not to mount the external power supply on a horizontal surface because this position does not allow heat dissipation. External power supplies must be mounted on vertical surfaces.
- In order to assure proper heat dissipation, external power supplies must be mounted in a vertical position with the power socket downwards (see Fig. 3.3.6 a,b).

Once you have chosen a location for the Remote Unit, please follow these instructions:

1. In order to install the M4 screw anchors (not included) which hold up the TFAx Remote Unit, drill into the wall according to the proper layout shown in Fig. 3.3.9.
2. Fix the TFAx to the wall by firmly tightening the screws into the anchors.
3. In order to install the M4 screw anchors (not included) which hold up the power supply external adapter, drill into the wall according to the proper layout of your power supply, shown in fig.3.4.10b
4. Fix the external power supply adapter to the wall by firmly tightening the screw into the anchors.
5. Fix the splice holder inside the splice tray (not included) See Fig. 3.3.7 a,b.
6. Splice the optical fibres and close the splice tray. While handling the fibers, be careful not to bend them.
7. Fix the splice tray beside the Remote Unit.
8. Connect the external adapter to the TFAx Remote Unit with the proper cable.
9. If the Remote Unit is -48 Vdc powered, use the -48 Vdc plug (included) in order to connect the external adapter to the -48 Vdc supply (Fig. 3.3.6 b). If the Remote Unit is 90/264 Vac-powered, fix the 90/264 Vac plug (included) onto a power cord (not included), and use this cable to connect the external adapter to the mains (Fig. 3.3.6 a).
10. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors.
11. Once the installation is finished, please follow the section "TFAx Case B Start-up" in order to carry out a proper system start up.

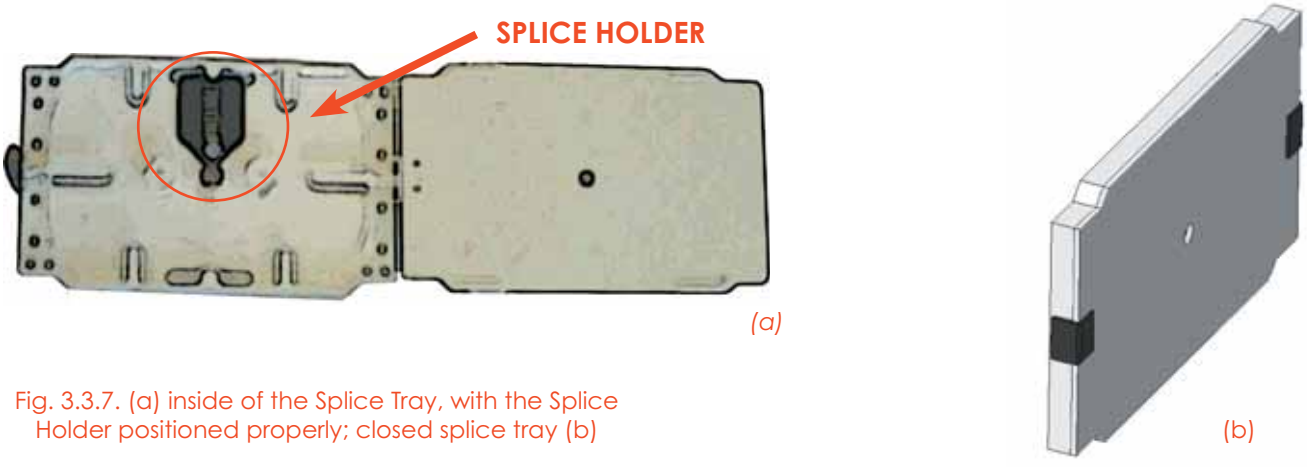


Fig. 3.3.7. (a) inside of the Splice Tray, with the Splice Holder positioned properly; closed splice tray (b)

Installation of the Case B Remote Unit WITH the TKA04 installation kit

The TFAx Case B kit includes:

1. a Remote Unit TFAx
2. a 50 Ω load
3. a TPSN external power supply adapter (86 to 264 Vac or -72 to -36 Vdc, according to the chosen model)
4. a VDE connector or a -48 Vdc plug (according to the chosen model)

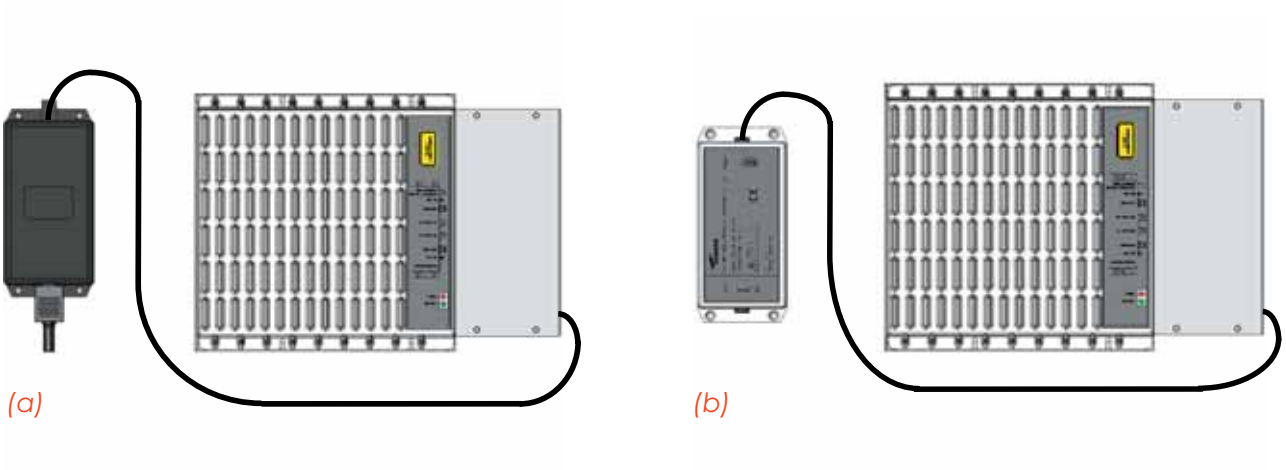


Figure 3.3.8:
Example of proper mounting configuration, which assures proper heat dissipation. Note that the Remote Unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The Figures refer to a 90/264 vac TFAx Case B (a) and to a -36/-72 Vdc TFAx Case B (b), respectively.

The TKA04 kit includes:

A. four screw anchors (fixing the wall bearing to the wall)
B. five screw anchors (fixing the TFAx Case B to the wall bearing)
C. a wall mounting box (wall bearing + cover)
D. a splice holder

Please consider these guidelines carefully in order to decide the proper positioning of the Remote Unit and its power supply:

- Under no circumstances should any piece of equipment be affected by the heat created by any other piece. The Remote Unit and its external power supply should be mounted so as to avoid reciprocal heating. Side-by-side configuration is suggested (Fig. 3.3.8 a,b)
- It is strongly recommended not to mount the external power supply on a horizontal surface because this position does not allow for heat dissipation. External power supplies must be mounted on vertical surfaces.
- In order to assure proper heat dissipation, the external power supplies must be mounted

in a vertical position with the power socket downwards (see Fig. 3.3.8 a,b).

Once you have chosen the position of the Remote Unit mounting case, please follow these instructions:

1. Unscrew the 4 screws which lock the lower cover of the TKA04 wall bearing (see Fig. 3.3.12 a)
2. In order to install the M4 screw anchors (included) which hold up the TKA04 wall bearing, drill into the wall according to the TKA layout shown in Fig. 3.3.11.
3. Fix the TKA04 wall bearing by firmly tightening the screws into the anchors.
4. In order to install the M4 screw anchors (not included) which hold up the power supply external adapter, drill into the wall according to the power supply layout shown in Fig.3.4.10 b.
5. Fix the external power supply adapter to the wall by firmly tightening the screws into the anchors (Fig. 3.2.13 b).
6. Carefully open the splice tray by using a screwdriver as in Fig. 3.3.12 c. Fix the splice holder inside the splice tray (Fig. 3.3.6 a). Splice the optical fibres and close the splice tray. While handling the fibers, take care not to bend them. Close the splice tray.
7. Fix the Remote Unit to the wall-bearing by using the included screws (Fig. 3.3.6 b).
8. If the Remote Unit is -48 Vdc powered, use the -48 Vdc plug (included) in order to connect the external adapter to the -48 Vdc mains (Fig. 3.3.8 b). If the Remote Unit is 90/264 Vac-powered, fix the 90/264 Vac plug (included) onto a power cord (not included), and use this cable in order to connect the external adapter to the mains (Fig. 3.3.8 a).
9. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors (Fig. 3.3.12 e). If the power cable has properly been connected to the mains, both the green and the red LEDs should turn on. The green LED will remain lit to indicate that the unit is powered on, while the red LED will turn off as soon as the local unit is switched on (for further details about the start up of the system, please refer to the section “TFAx Case B Start-up”)
10. Fix the lower cover by fastening the 4 screws (Fig. 3.3.12 f)

TFAx Case B Start-Up

Before the TFAx Remote Unit is switched on, make sure that:

- the modules hosted in the master unit have been connected to each other with RF jumpers, according to the system design
- every TFLN master optical TRX has been connected to its Remote Units
- each Remote Unit has been connected to its coverage antennas

For a correct system start-up, all the Remote Units have to be switched on prior to the master unit.

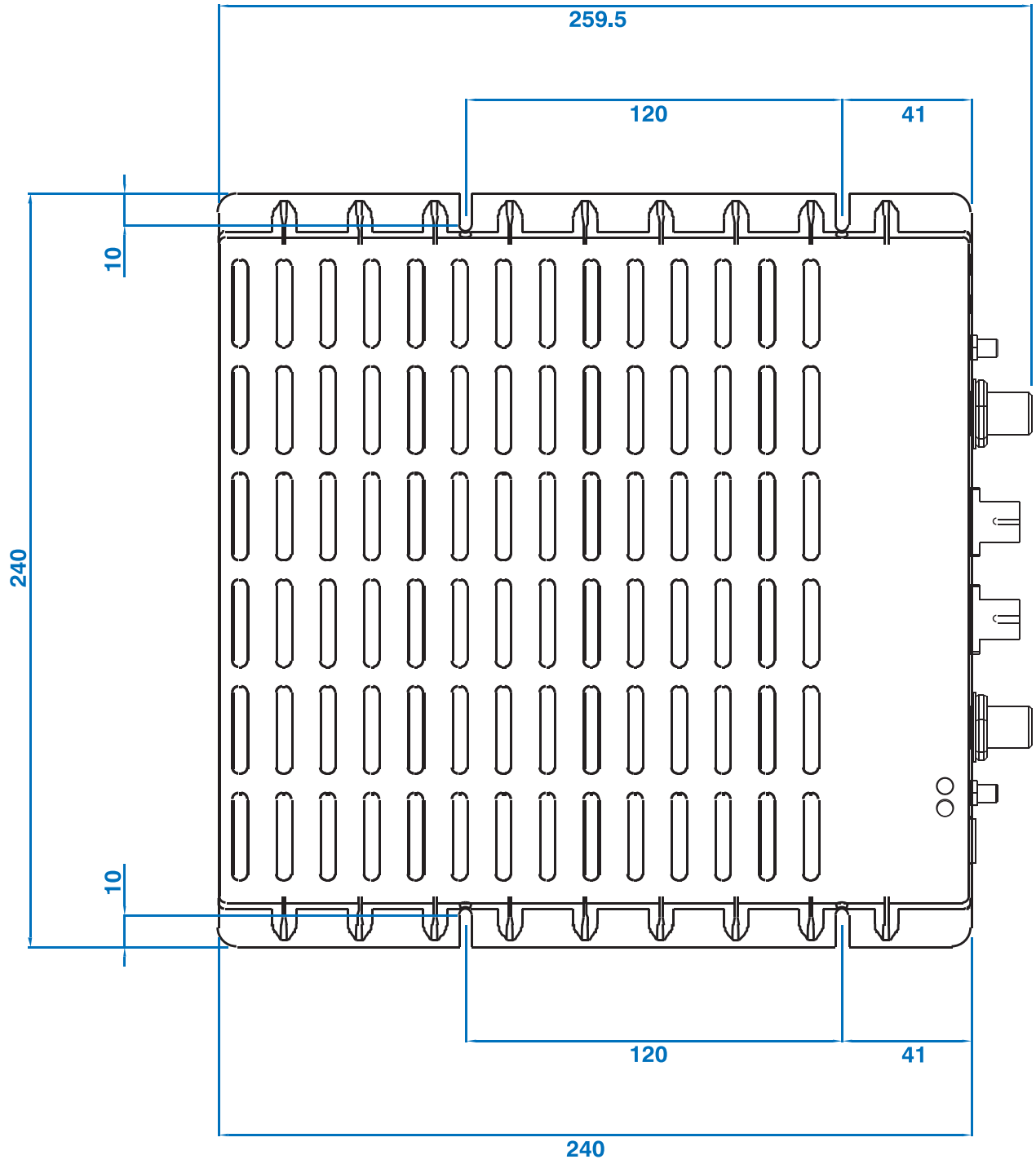
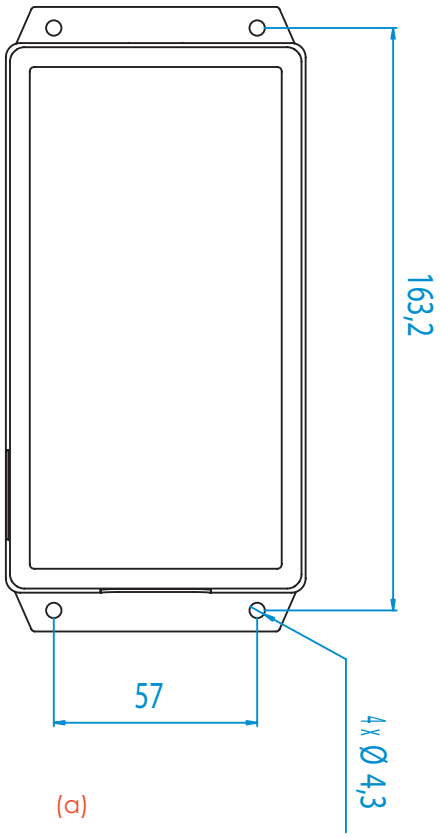


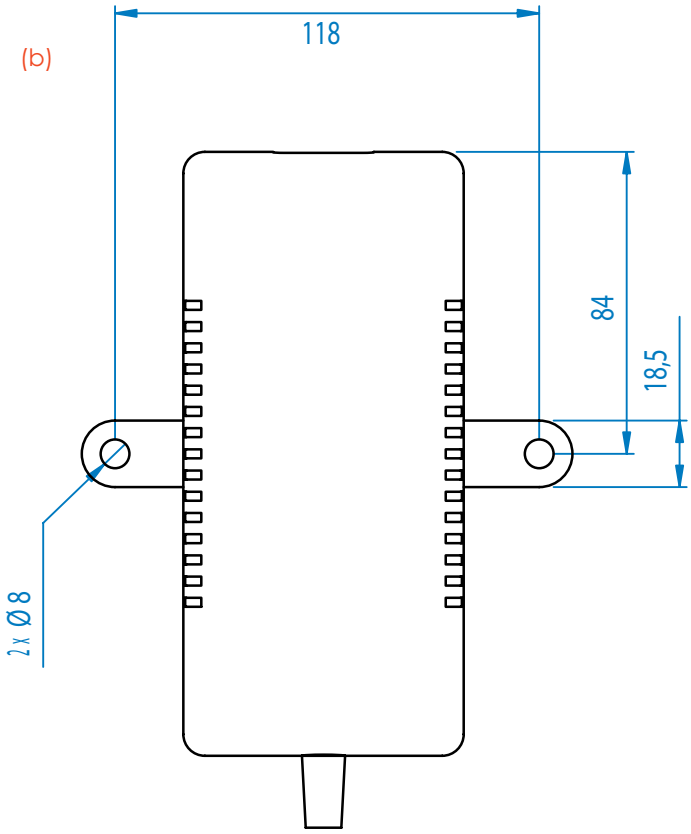
Figure 3.3.9 : Case B layout with wall anchor quotes



(a)

Figure 3.3.10:
(a) Layout of the 220Vac/+5Vdc power adapter, provided with Case B Remote Units.
(b) Layout of the 220Vac/+5Vdc power adapter, provided with Case B Remote Units.

(b)



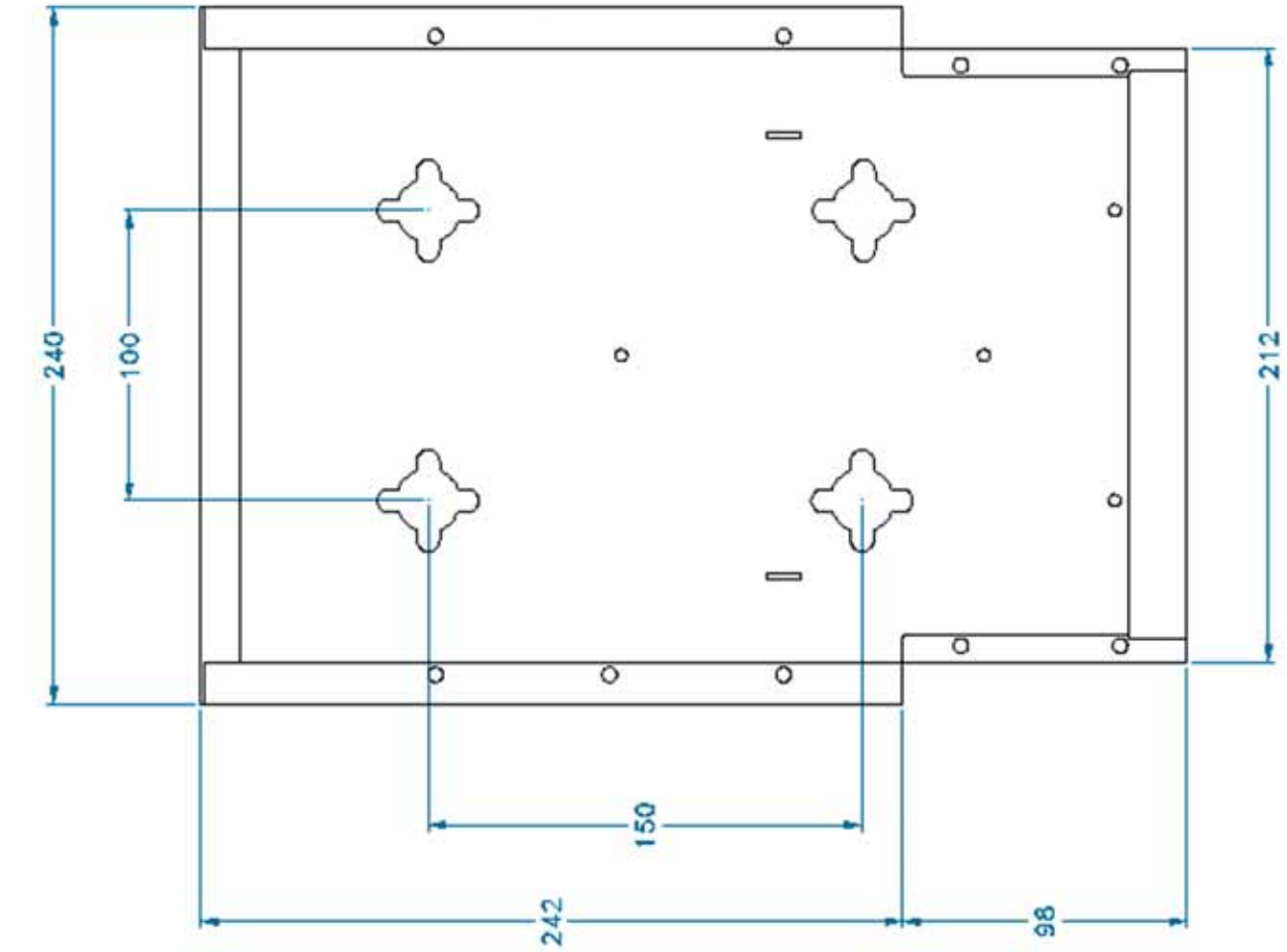


Figure 3.3.11: Layout of the TKA installation kit, provided with Case B Remote Units.

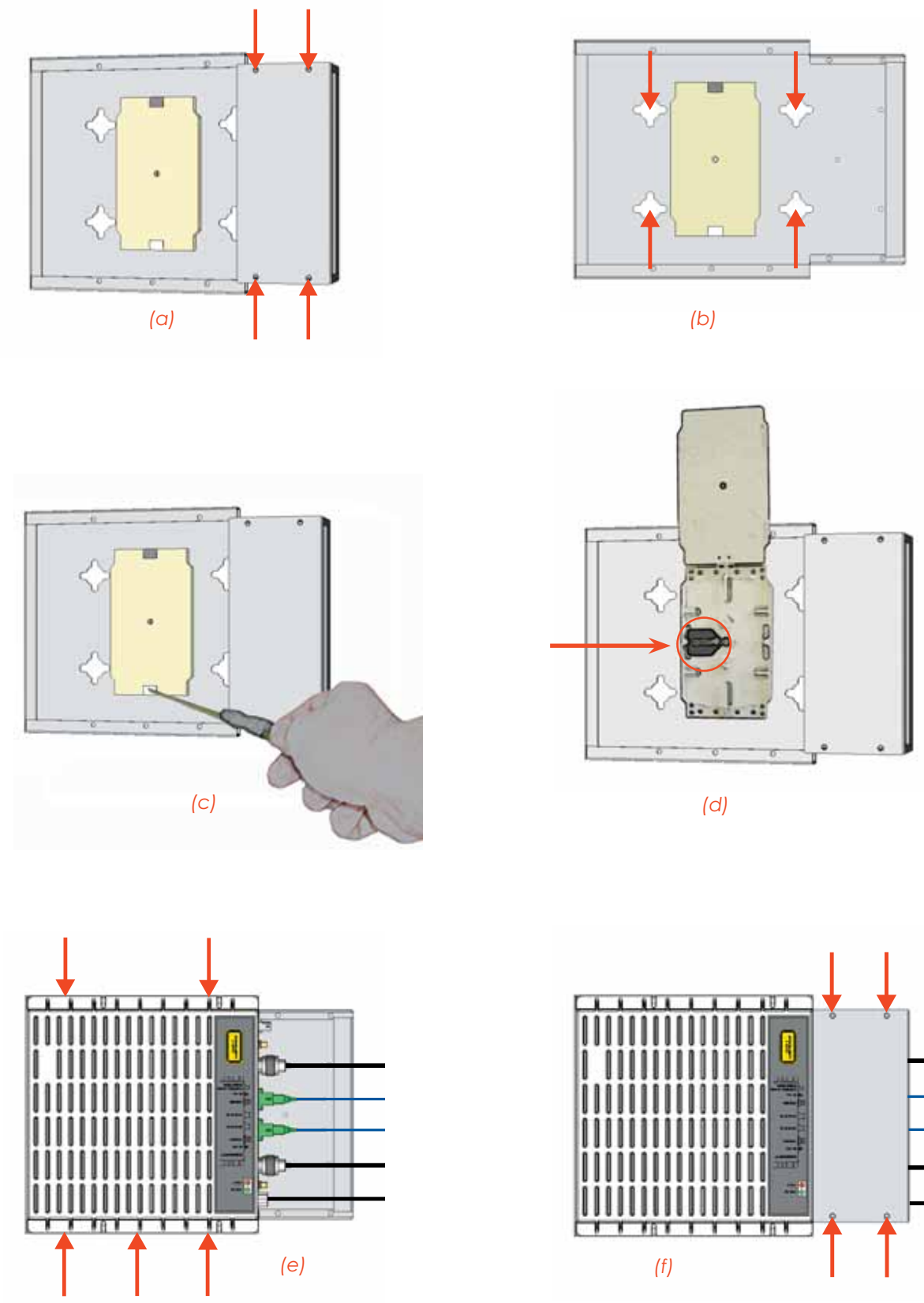


Figure 3.3.12: Mounting the TFAx Remote Unit with a TKA installation kit.
Please not that the Figures do not show the mounting of the external power supply.adapter.

Once the TFAx has been switched on, its behaviour can be summarized as per the following indicators:

1. When the Remote Unit is turned on, both the LEDs upon the warm side turn on for a couple of seconds
2. After that, the unit's green LED remains on (thus indicating proper power supply), while the red LED switches off as soon as the master unit is turned on (meaning that DL optical power is OK and no alarms are present).
3. Once the master unit has been switched on, the status of both LEDs should be those indicated in Table 3.3.1. In case the red LED remains on, please refer to the Troubleshooting section.
4. After being switched on, the Remote Unit should start up correctly and in order to be recognized by the supervision management system, the corresponding TFLN master optical TRX should carry out the discovery phase (please refer to the Supervision System Manual for more details). During this phase, which can last for up to a max. 4min, depending on the system complexity, the TFLN LED ⌐┘ blinks. Do not connect/disconnect any cables or pieces of equipment during the discovery phase! This may result in the identification failure of the Remote Unit.

Note: in case discovery doesn't start automatically, check through either the LMT or the remote supervision for whether it has been disabled (refer to LMT or remote Supervision System manuals for further information).

TFAx Case B Troubleshooting

Faults can be revealed by LEDs on the TFAx front panel, as well as by LMT or the Supervision System (running on the remote supervision unit)
Both the LMT and the Supervision System are able to provide complete information about the cause of the alarm. As a consequence, troubleshooting procedures can be immediate when failure detection is carried out directly through either the LMT or the Supervision System.
ION-B modules are designed to exchange information, meaning that each Remote Unit can receive failure notifications from its external equipment through dry-contact connections. Moreover, the TFAx constantly monitors the optical signal received from its TFLN unit to control optical losses.

Tables 3.3.2 shows a brief description of the alarms related to the Case B Remote Unit, with reference to the corresponding alerted LEDs and to the actions to be carried out in case of a fault.

As the Tables show, minor alarms (low priority alarms) are revealed only by either the LMTs or

ALARM CODE (TSUN description)	ALARM DESCRIPTION	ACTIVE LED	SUPERVISION PRIORITY LEVEL	ACTION RECOMMENDED	RELÉ PRIORITY LEVEL (subrack)
Antenna DC loop alarm	ALWAYS OK				
DL optical power fail[1]	The optical power received on the DL is too low and can't no more be compensated	RED	MAJOR	Check the DL fibre and the TFLN laser status	MAJOR
AGC out of range[1]	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	WARNING	Clean optical connectors	MINOR
DL RF alarm in Band 1	HW failure on the DL low band RF section	RED	CRITICAL	Return the unit	MAJOR
DL RF alarm in Band 2	HW failure on the DL high band RF section	RED	CRITICAL	Return the unit	MAJOR
DL RF alarm in Band 3 (if present)	HW failure on the DL UMTS band RF section	RED	CRITICAL	Return the unit	MAJOR
External 1 alarm	Alarm on the device connected on dry-contact 1	RED	MAJOR	Check the external device or alarm connection	MAJOR
External 2 alarm	Alarm on the device connected on dry-contact 2	RED	MAJOR	Check the external device or alarm connection	MAJOR
Power supply alarm	UPS HW failure or malfunction. RF is turned OFF	RED	MAJOR	Check the external PSU. If it works properly, return the unit	MAJOR
Internal BUS alarm	A malfunctioning on the digital part involves a fault in monitoring functionalities	RED	CRITICAL	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	MINOR	Check ventilation and environment	MINOR

Table 3.3.2: Description of the alarms of the Case-B Remote Unit, as they are presented by the LMT application or by the Supervision interface

the Supervision Systems, and not through LEDs. Minor alarms detect critical situations which should be checked and tested in order to avoid future possible system faults.

Each Remote Unit is provided with an AGC system which comes in after the optical-to-RF conversion. This AGC is able to correctly compensate optical losses when these are estimated to be <3.5 dB. In case optical losses are > 3.5dB, the LMT application and the ION-B supervision unit will display a "Warning" alarm: the whole system still work, but AGC is near to its borderline levels.
The red LED switches on when the estimated optical losses are >4.5 dB, the AGC not being able to compensate these losses any more.

Fig. 3.3.13: AGC thresholds vs LED alerts

As shown in the previous table, the same red LED switches on to reveal any major failures. By following the next troubleshooting procedure, it will be possible to better understand what problem has occurred.

Note:
Each Remote Unit is provided with an AGC system which kicks in after the optical-to-RF conversion. This AGC can correctly compensate for optical losses when they are estimated to be <3.5 dB. In case optical losses are > 3.5dB, the LMT application and the ION-B supervision unit will display a "Warning" alarm: the whole system still work, but AGC is near to its borderline levels.
The red LED switches on when the estimated optical losses are >4.5, because the AGC is not able to compensate for these losses anymore.

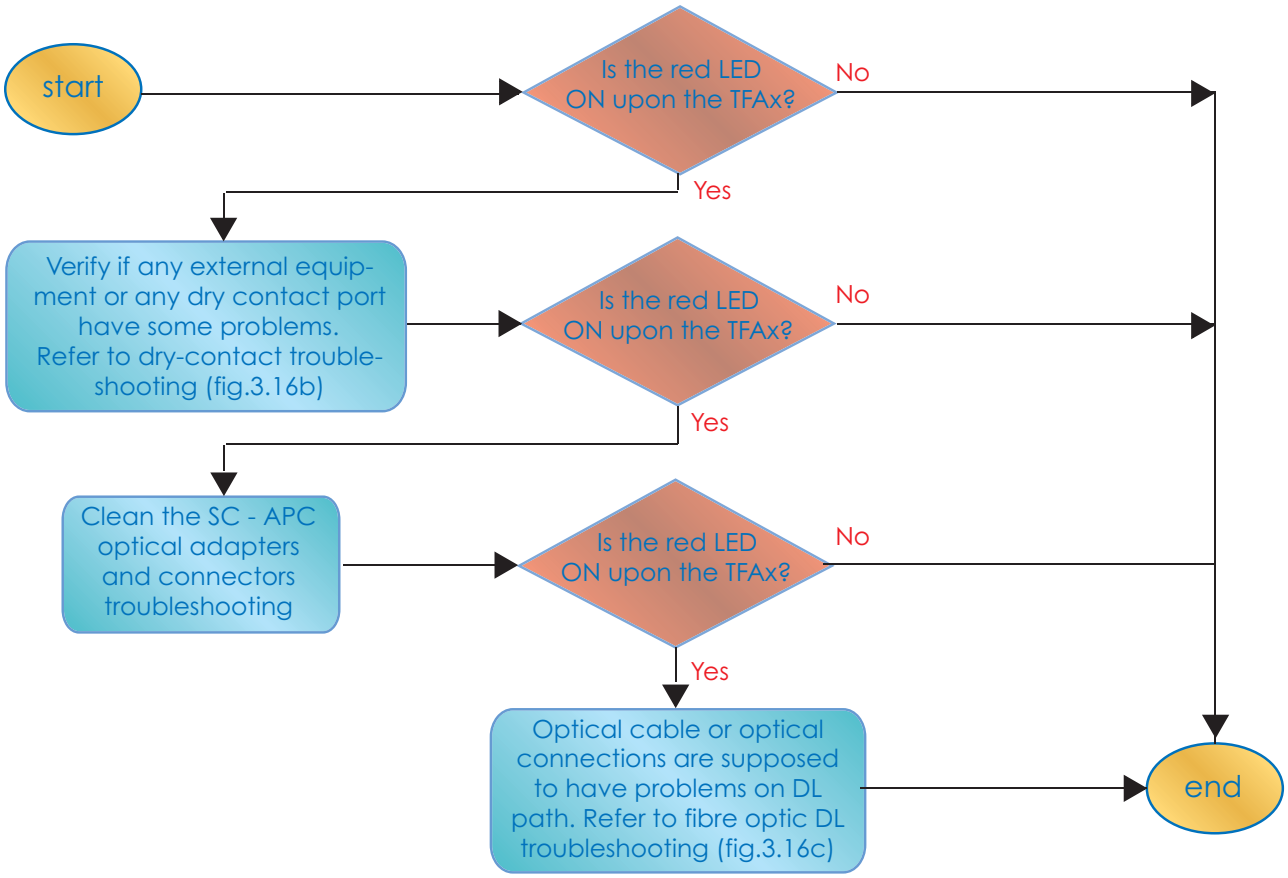


Figure 3.3.14 (a): Flow-chart describing the quick troubleshooting procedure of a TFAx Case B

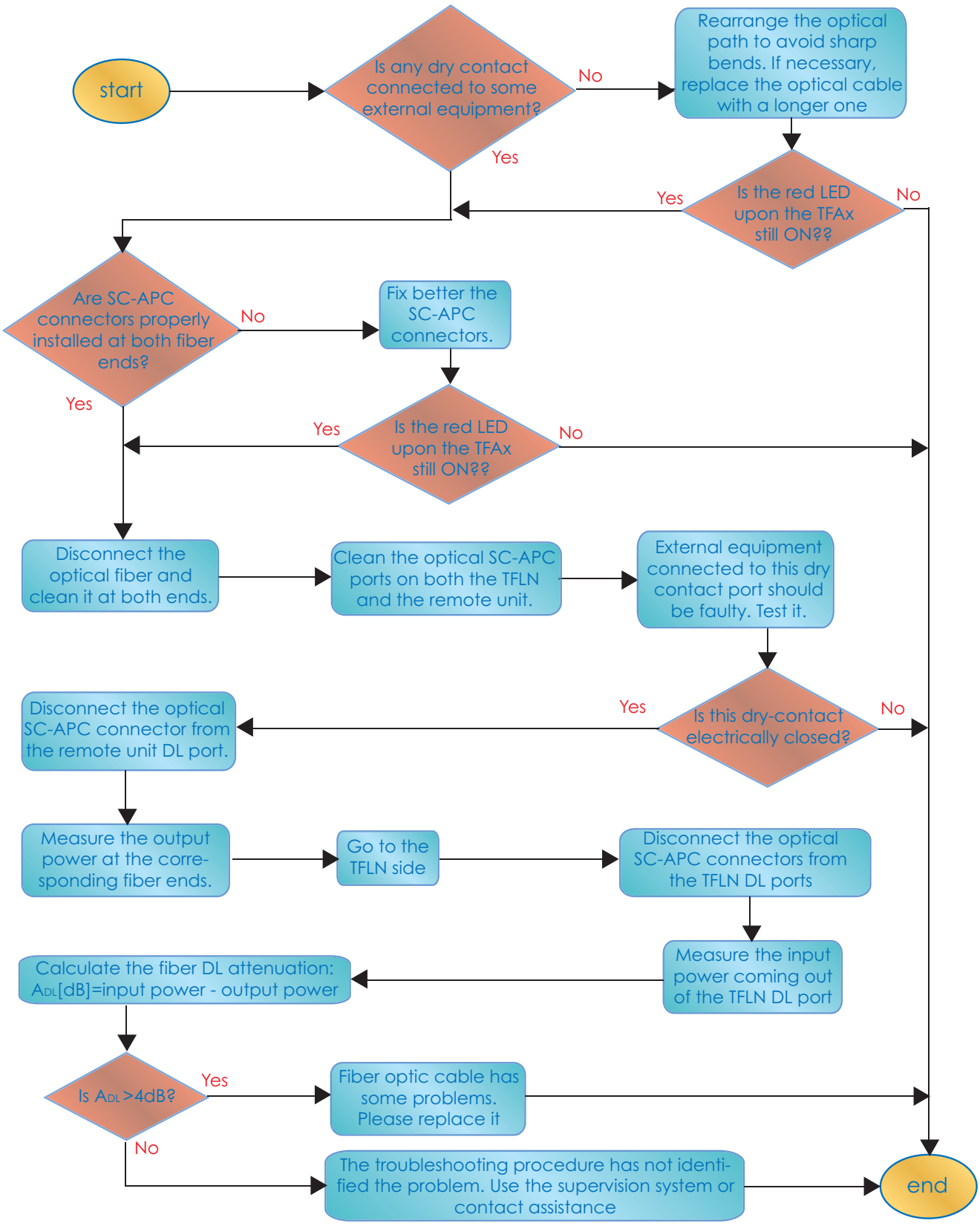


Figure 3.3.14 (b): Flow-chart describing the quick troubleshooting procedure of a TFAx Case B

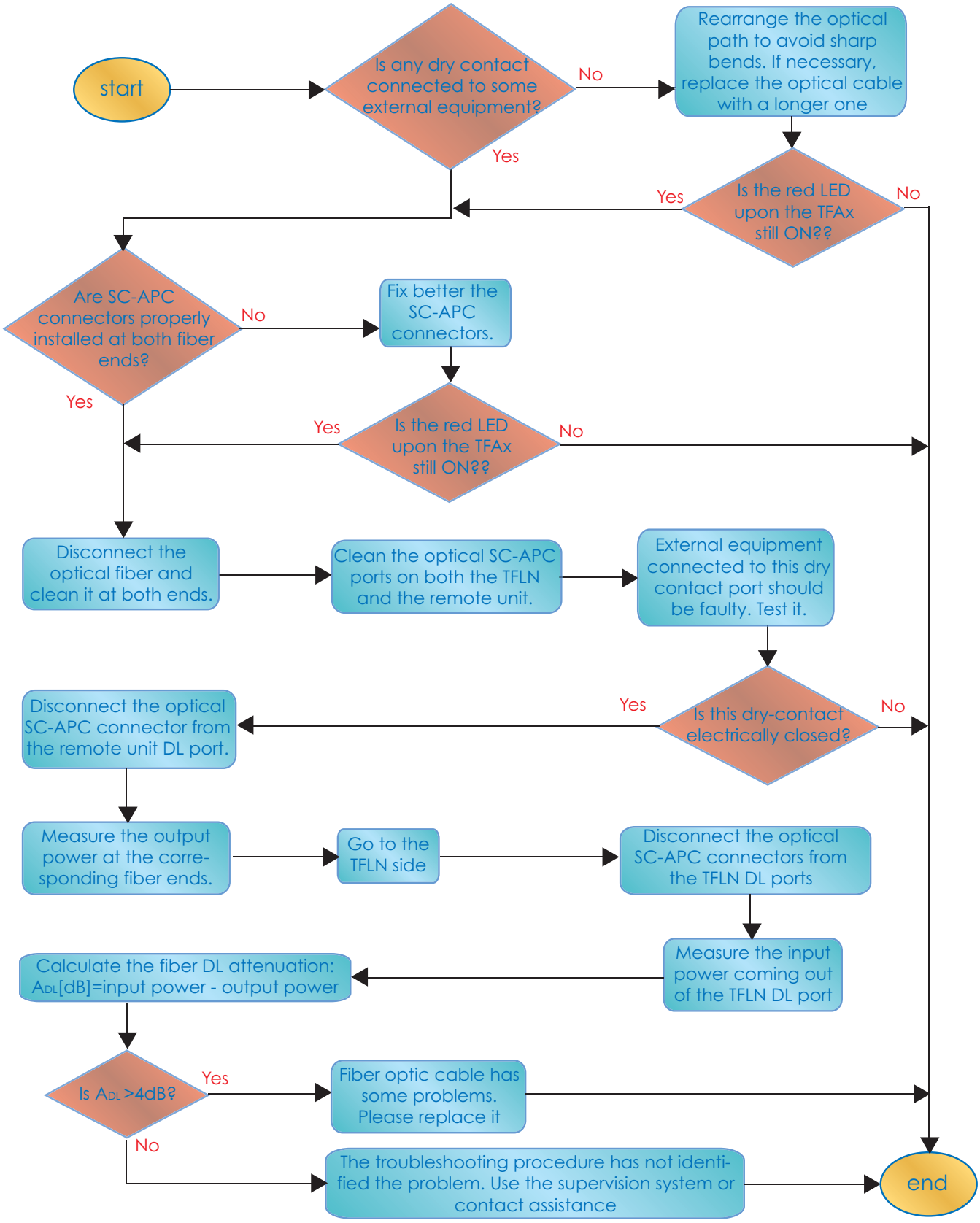


Figure 3.3.14 (c): Flow-chart describing the quick troubleshooting procedure of a TFAx Case B

As shown in the previous table, the same red LED switches on to reveal any major failures. By following the next troubleshooting procedure, it will be possible to better understand what problem occurred.

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in Fig. 3.3.14a)

If the red LED is LIT, please follow these steps:

1. Refer to dry-contact troubleshooting in order to discover whether or not the alarm is a result of external equipment failure.
2. If dry-contact troubleshooting has not revealed any failures, clean the optical adapters.
3. If the problem still persists, refer to the fibre optic DL troubleshooting procedures to see if the optical cables or connections have any problems along the DL path.
4. If none of the previous actions served to switch off the LED, replace the unit with a new one or contact for assistance.

Dry-contact troubleshooting

(The following procedure is summarized by the flow-chart in Fig. 3.3.14b)

This procedure should be considered if at least one TFAx dry-contact is connected to any external equipment. If not, return to main troubleshooting procedure.
These steps aim to detect any failure inside external equipment or dry-contact ports. If the dry-contacts aren't able to reveal any equipment malfunctions or port failures, then return to the main troubleshooting procedure.
For any dry-contact that is connected to external equipment, follow these steps:

1. Disconnect it, and check the TFAx LED status after the disconnection.
2. If the red LED has switched off, any external equipment that is connected to the dry contact port is probably faulty. Please test it.
3. If the TFAx red LED still remains on after the disconnection, measure the voltage between the terminals of the dry contact port.
    a. If the terminals are electrically closed, the dry-contact port is faulty. Contact the manufacturer for assistance.
    b. If the terminals are open, this means neither the analysis of the present dry contact nor the one of its external equipment has revealed failures. Re-connect the present dry contact port to its external equipment. If the TFAx has any other unchecked dry-contacts connected to external equipment, apply the whole procedure (i.e. steps 1-3) to this new port

Fibre optic DL troubleshooting

(The following procedure is summarized by the flow-chart in Fig. 3.3.14c)

1. Check to see if there are any points in which fibres are experiencing a short radius of curvature. In these cases, rearrange the optical path in order to avoid sharp bends (if necessary, replace the optical cable with a longer one). If the TFLN red LED switches off, troubleshooting has been successfully carried out. Otherwise, follow the next steps.
2. Check to see if SC-APC connectors are properly installed at both fibre ends. In case they are not, replug the SC-SPC connectors to adapters. If the TFLN red LED switches off, troubleshooting has been successful. Otherwise, follow the next steps.
3. Disconnect the optical fibre and clean it at both ends, then clean the SC-APC ports on both the TFLN and the Remote Unit. Re-connect the fibre to relevant ports after cleaning. If it hasn't made the TFLN red LED switch off, follow the next steps.
4. Disconnect the optical SC-APC connector from the Remote Unit's DL port, and measure the output power POUT(DL) at the corresponding fibre end. Then, go to the TFLN side, disconnect the optical SC-APC connector from the TFLN DL port and measure the input power PIN(DL) coming out of the TFLN DL port. Calculate the DL fibre attenuation ADL as ADL [dB] = PIN(DL) – POUT(DL)
    a. If ADL > 4dB, then there are problems with the fibre optic cable. Replace it with a new one.
    b. If ADL < 4dB, the troubleshooting procedure has not identified the problem. Refer to the Supervision System or contact assistance.

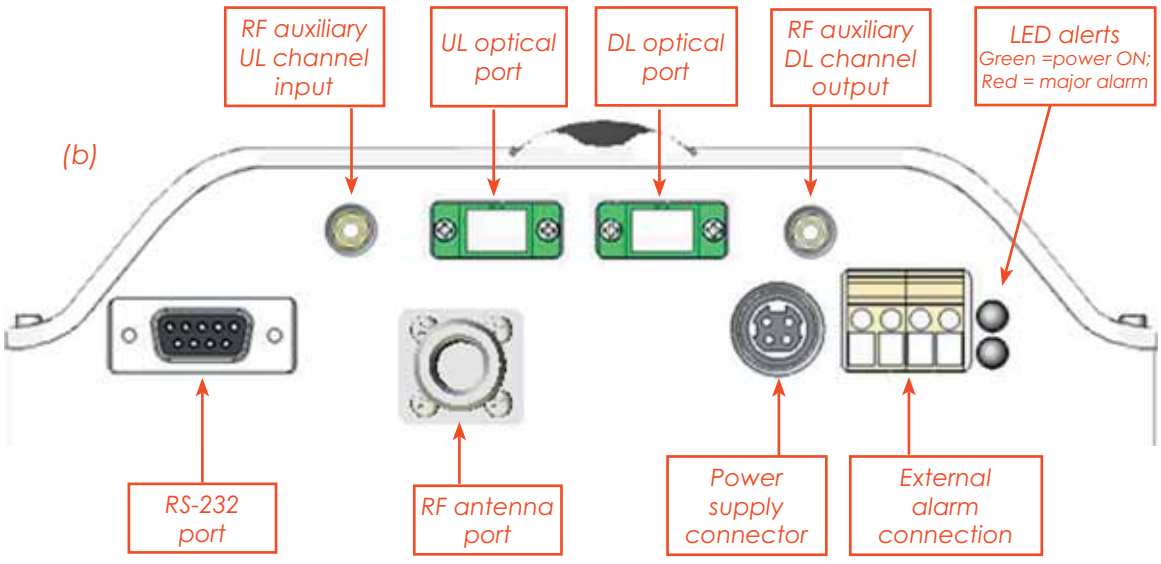
3.5. Case R Remote Unit

Dimensions and Weight

Dimensions: mm. 564 x 255 x 167
(inches 21.5 x 10 x 8.1)

Weight: please refer to the Remote Unit dedicated bulletin in order to know the updated data about the weight of your case-R Remote Unit.

Figure 3.4.1: ION-B, Case-R Remote Unit: (a) Remote Unit view; (b) front view



RF ports:

- 1 RF antenna port, transmitting/receiving signals to/from distributed antennas. This RF antenna port is a duplexed N-female connectors. The port can be connected to the antenna either directly (ie. through RF jumper cables) or through splitters, thus allowing more antennas to be fed.
- 1 RF auxiliary input and 1 RF auxiliary output (designed to receive and transmit additional signals). Auxiliary input and output ports are SMA-female connectors.

Optical ports:

- 1 optical output port, transmitting UL signals to TFLN master optical TRX;
- 1 optical input port, receiving DL signals from TFLN master optical TRX.

Visual alarms:

Two control LEDs are provided on the Case-R upper side (fig. 3.4.2).
The green LED describes the power supply status, while the red LED describes the major Remote Unit failures.

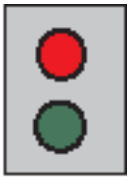


Figure 3.4.2:
LED alarms on the upper-front side of Case B Remote Units (including Power version)

Led colour	Meaning
Red	Low optical power at DL input and/or RF amplifier failure
Green	Power supply OK

Table 3.4.1 - Description of the LEDs of Case-R remote unts

External alarms

Case-R TFAx is provided with two dry contact inputs which can be connected (through .062" MOLEX plugs) to any external device. The alarm information regarding this external device is able to be signalled through the red LED of the TFAx LED panel and displayed on the Supervision System in this way.

Figure 3.4.3:
LED alarms on the upper-front side of Case B Remote Units (including Power version)

Power supply:

Case-R Remote Unit is provided with a TPSN external power supply (Fig. 3.4.4 a,b), available either for universal mains (90 to 264) or for negative supply. (-72 to -36 Vdc).
Before installing your Remote Unit, please check you have been provided with the proper external power supply. Should you have any doubt, please contact your Sales representative.
The nominal Voltage provided by the TPSN external power supply is +28Vdc.

Figure 3.4.4. TPSN External Power Supply for TFAx Case-R Remote Unit

Warnings (to be read before Remote Units are installed)

Dealing with optical output ports

The Case-R Remote Unit contains semiconductor lasers. Invisible laser beams may be emitted from the optical output ports. Do not look towards the optical ports while equipment is switched on.

Choosing a proper installation site for the Remote Units

- Case-R Remote Units have to be installed as close as possible to the radiating antennas, in order to minimize coaxial cable length, thus reducing downlink power loss and uplink noise figure.
- When positioning the Case-R Remote Unit, pay attention that the placing of related antennas should be decided in order to minimize the Minimum Coupling Loss (MLC), so as to avoid blocking.
- The Case-R Remote Unit is intended to be fixed on walls or other flat vertical surfaces.

Handling optical connections

- When inserting an optical connector, take care to handle it so smoothly that the optical fibre is not damaged. Optical fibres are to be single-mode (SM) 9.5/125µm.
- Typically, ION-B equipment is provided with SC-APC optical connectors (other connectors may be provided on request). Inserting any other connectors will result in severe damages.
- Do not force or stretch the fibre pigtail with radius of curvature less than 5cm. See rightward figure for optimal fibre cabling.
- Remove the adapter caps only just before making connections. Do not leave any SC-

APC adapter open, as they attract dirt. Unused optical connectors must always be covered with their caps.

- Do not touch the connector tip. Clean it with a proper tissue before inserting each connector into the sleeve. In case connector tips need to be cleaned, use pure ethyl alcohol.

TFAx Case-R installation

Each Cabinet-R Remote Unit kit includes:

- 1 Cabinet-R Remote Unit;
- 1 power supply cable (85 to 264 Vac or -48Vdc, depending on the power supply which has been chosen);
- 1 pair of mounting plates;
- 1 screw kit, including four hexagonal-head screws and a torque key.

The operations which need to be carried out in order to perform a proper installation of the Cabinet-R Remote Unit are hereby described.
The Cabinet-R Remote Unit has to be mounted with heat-dissipation fins in vertical position.
The suggested installation layout is shown in Figure 3.4.5a, with the external power supply mounted side by side to the Remote Unit, using a common screw anchor to support both the Remote Unit's right side and the power supply's left wing.

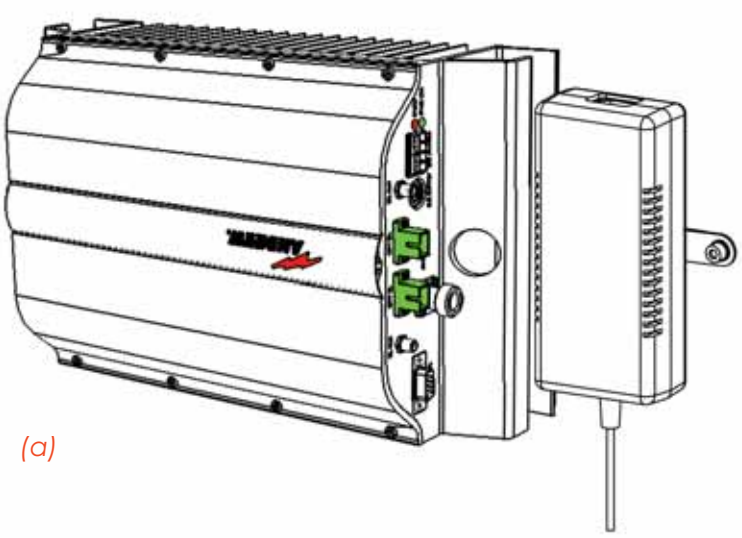
An external splice box (not included) may be mounted side by side to the power supply or to the Remote Unit, sharing an anchor with one of them (see pict 3.4.5g).

1 –Drill the wall to install the four M6 screw anchors (not included) according to the layout shown in Fig. 3.4.5b.
As an alternative, you can choose to install your power supply conveniently close to the Remote Unit.

2 –Insert the four M6 screw anchors in the holes, and fix the power supply to the wall (see fig. 3.4.5c). If you planned to use a common screw anchor to support both the Remote Unit and the external power supply, take care not to screw this anchors until you fixed the Remote Unit.

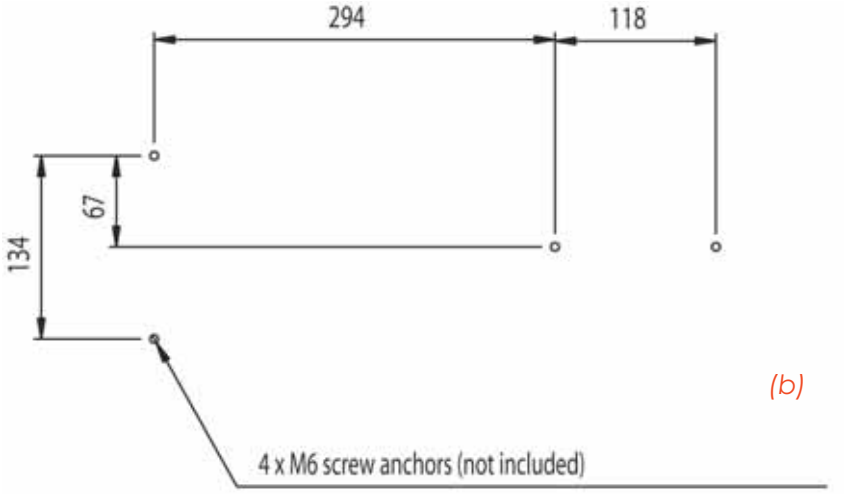
3 – Fix the Remote Unit to the wall and tighten the 4 screw anchors (Fig. 3.4.5d)

4 - Fix the splice holder (not included) inside a splice tray, like the one shown in Fig. 3.4.5e (not included).
Make the optical splices and close the splice tray (3.5.5f).
Place the splice tray inside a splice box (not included), and mount the splice box beside

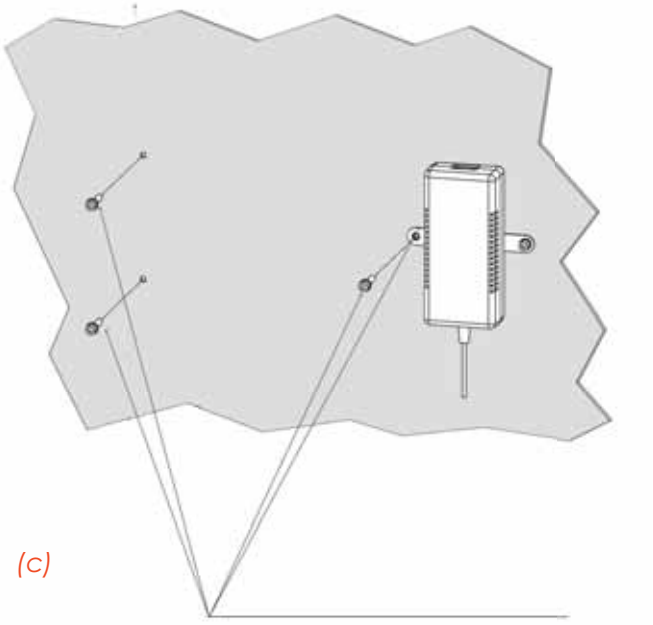


(a)

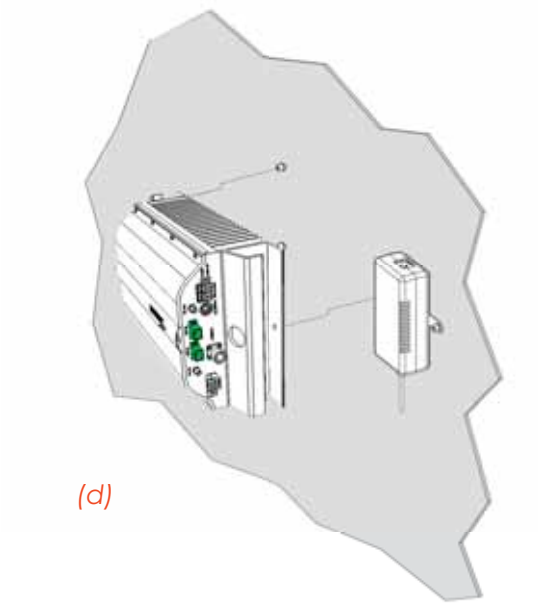
Figure 3.4.5:
Mounting the Case-R Remote Unit, Steps (a) - (c).



(b)

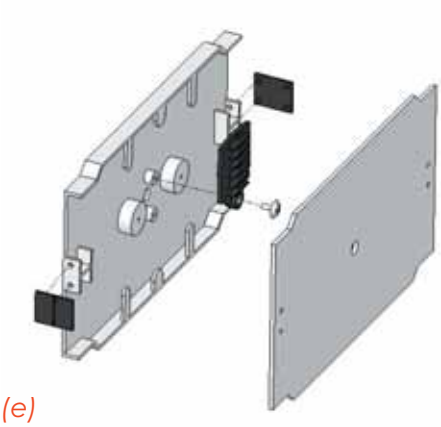


(c)



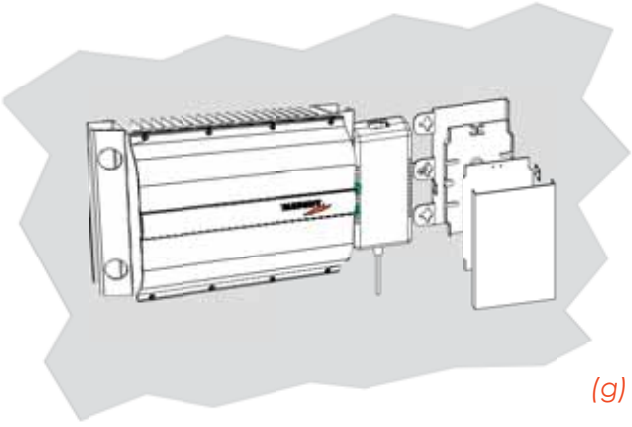
(d)

Figure 3.4.5:
Mounting the Case-R Remote Unit,
Steps (d) - (h).

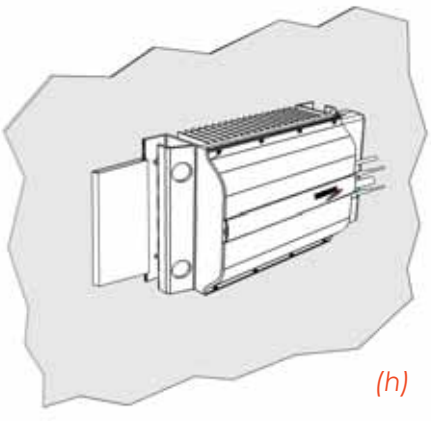


(e)

(f)

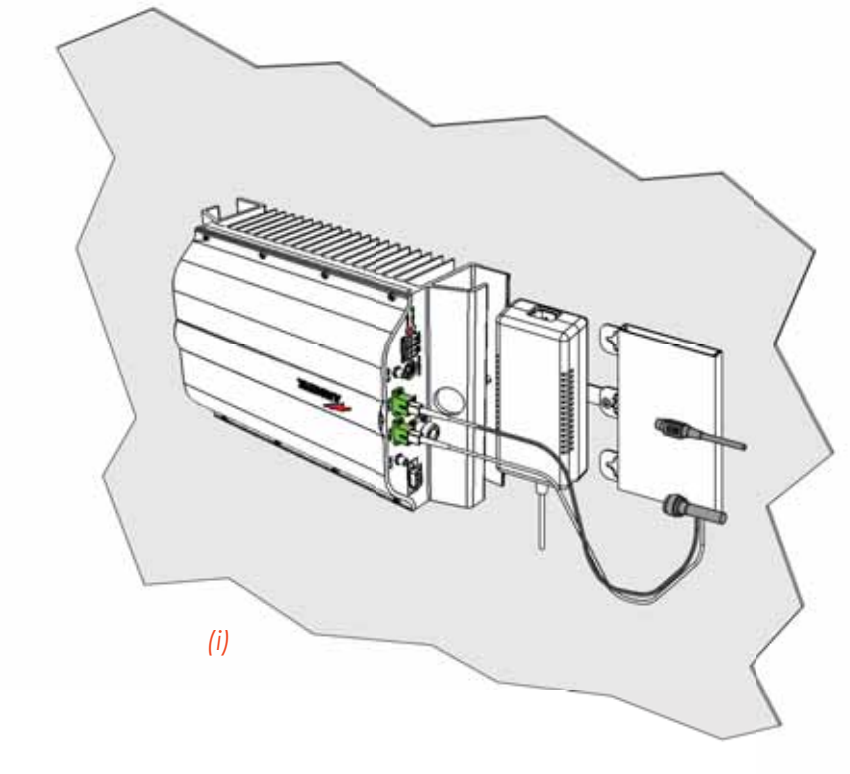


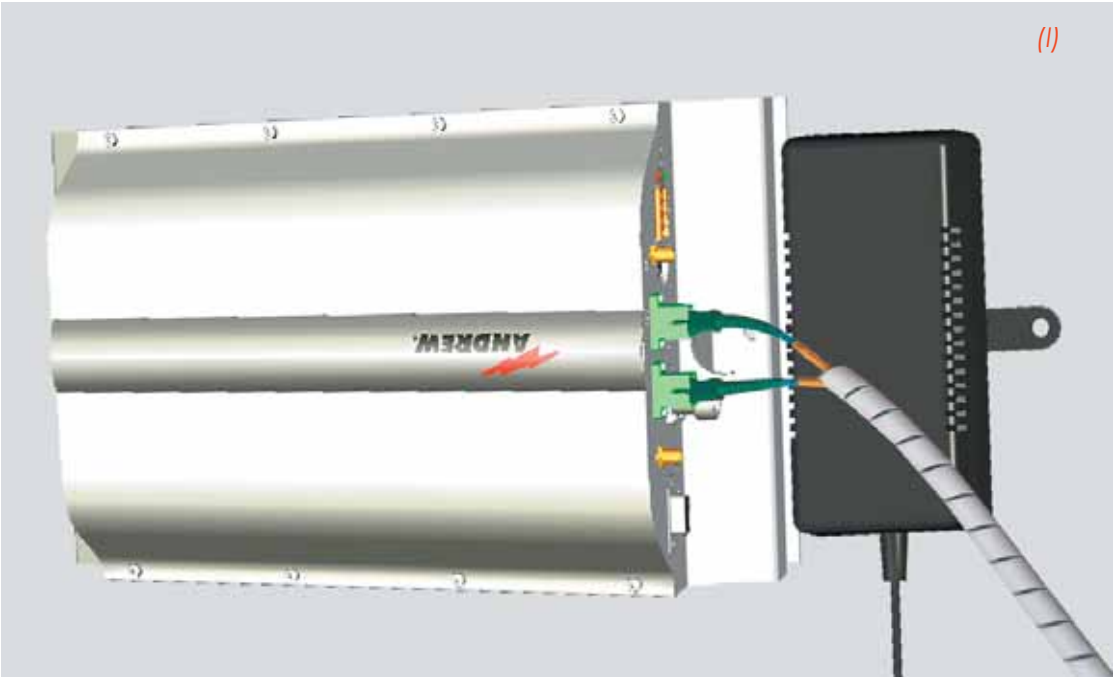
(g)



(h)

Figure 3.4.5:
Mounting the Case-R Remote Unit,
Steps (i) - (l).





the Remote Unit. The suggested installation position is side by side to the power supply or to the Remote Unit, using one of their M6 anchors already installed to support the splice box as well (please see Fig. 3.4.5g, 3.4.5h).
NOTE: Take care not to bend the fibers too much.

5 - Now connect the RF cables, the optical connectors, and the power supply connector to the Remote Unit (Fig. 3.4.5i). Take care to connect UL and DL fibers properly.
After the Remote Unit has been properly cabled, insert the power plug in the external power supply adapter, so as to connect it to the mains.
6 - A fiber protection can be placed around DL optical fibers (Fig. 3.4.5l).

TFAx Case R Troubleshooting

Please refer to the ***TFAx Case R and Case R2 troubleshooting*** for a full overview of the troubleshooting procedures for Case R Remote Units.

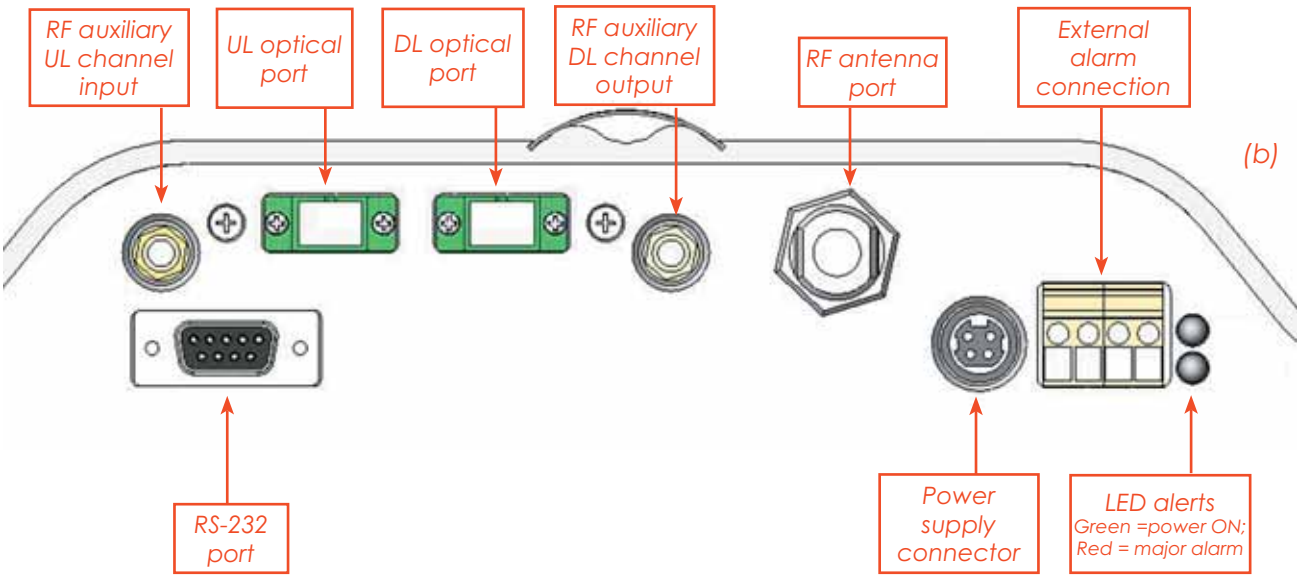
3.6. Case-R2 Remote Unit

Dimensions and Weight

Dimensions: mm. 564 x 255 x 167
(inches 21.5 x 10 x 8.1)

Weight: please refer to the Remote Unit dedicated bulletin in order to know the updated data about the weight of your case-F Remote Unit.

Figure 3.5.1: ION-B, Case-R2 Remote Unit: (a) fulll view; (b) front view



RF ports:

- 1 RF antenna port, transmitting/receiving signals to/from distributed antennas. This RF antenna port is a duplexed N-female connectors. The port can be connected to the antenna either directly (ie. through RF jumper cables) or through splitters, thus allowing more antennas to be fed.
- 1 RF auxiliary input and 1 RF auxiliary output (designed to receive and transmit additional signals). Auxiliary input and output ports are SMA-female connectors.

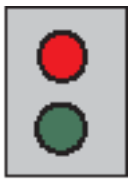
Optical ports:

- 1 optical output port, transmitting UL signals to TFLN master optical TRX;
- 1 optical input port, receiving DL signals from TFLN master optical TRX.

Visual alarms:

Two control LEDs are provided on the Case-R2 upper side (fig. 3.5.2).
The green LED describes the power supply status, while the red LED describes the major Remote Unit failures (fig. 3.9).

Figure 3.5.2:
LED alarms on the upper-front side of Case B Remote Units (including Power version)



Led colour	Meaning
Red	Low optical power at DL input and/or RF amplifier failure
Green	Power supply OK

Table 3.5.1 - Description of the LEDs of Case-R2 remote unts

External alarms

Case-R2 TFAx is provided with two dry contact inputs which can be connected (through .062" MOLEX plugs) to any external device. The alarm information regarding this external device is able to be signalled through the red LED of the TFAx LED panel and displayed on the Supervision System in this way.

Figure 3.5.3:
LED alarms on the upper-front side of Case R2 Remote Units (including Power version)

Power supply:

Each case-R2 Remote Unit must be ordered with a proper TPSN external power supply (Fig. 3.5.4), available either for universal mains (90 to 264) or for negative supply. (-72 to -36 Vdc).
Before installing your Remote Unit, please check you have been provided with the proper external power supply. Should you have any doubt, please contact your Sales representative.
The nominal Voltage provided by the TPSN external power supply is +28Vdc.

Figure 3.5.4. TPSN External Power Supply for TFAx Case-R2 Remote Unit

Warnings (to be read before Remote Units are installed)

Dealing with optical output ports

The Cabinet-R2 Remote Unit contains semiconductor lasers. Invisible laser beams may be emitted from the optical output ports. Do not look towards the optical ports while equipment is switched on.

Choosing a proper installation site for the Remote Units

- Cabinet R2 Remote Units have to be installed as close as possible to the radiating antennas, in order to minimize coaxial cable length, thus reducing downlink power loss and uplink noise figure.
- When positioning the Cabinet-R2 Remote Unit, pay attention that the placing of related antennas should be decided in order to minimize the Minimum Coupling Loss (MLC), so as to avoid blocking.
- The Cabinet-R2 Remote Unit is intended to be fixed on walls or other flat vertical surfaces.

Handling optical connections

- When inserting an optical connector, take care to handle it so smoothly that the optical fibre is not damaged. Optical fibres are to be single-mode (SM) 9.5/125µm.
- Typically, ION-B equipment is provided with SC-APC optical connectors (other connectors may be provided on request). Inserting any other connectors will result in severe damages.
- Do not force or stretch the fibre pigtail with radius of curvature less than 5cm. See rightward figure for optimal fibre cabling.
- Remove the adapter caps only just before making connections. Do not leave any SC-

APC adapter open, as they attract dirt. Unused optical connectors must always be covered with their caps.

- Do not touch the connector tip. Clean it with a proper tissue before inserting each connector into the sleeve. In case connector tips need to be cleaned, use pure ethyl alcohol.

TFAx Case-R2 installation

Each Case-R2 Remote Unit kit includes:

- 1 Case-R2 Remote Unit;
- 1 power supply cable (85 to 264 Vac or -48Vdc, depending on the power supply which has been chosen);
- 1 pair of mounting plates;
- 1 screw kit, including four hexagonal-head screws and a torque key.

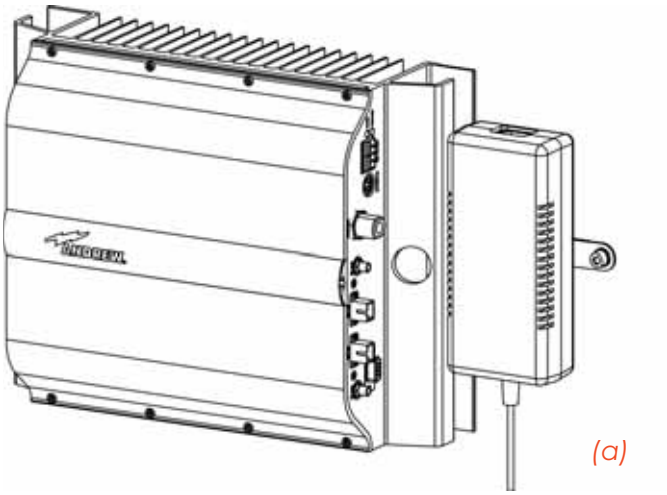
The operations which need to be carried out in order to perform a proper installation of the Case-R2 Remote Unit are hereby described:
The Cabinet-R2 Remote Unit has to be mounted with heat-dissipation fins in vertical position.
The suggested installation layout is shown in Figure 3.5.5a, with the external power supply mounted side by side to the Remote Unit, using a common screw anchor to support both the Remote Unit's right side and the power supply's left wing.
An external splice box (not included) may be mounted side by side to the power supply or to the Remote Unit, sharing an anchor with one of them (see pict 3.5.5g).

1 – Drill the wall to install the four M6 screw anchors (not included) according to the layout shown in Fig. 3.5.5b.
As an alternative, you can choose to install your power supply conveniently close to the Remote Unit.

2 – Insert the four M6 screw anchors in the holes, and fix the power supply to the wall.
If you planned to use a common screw anchor to support both the Remote Unit and the external power supply, take care not to screws this anchors till you fixed the Remote Unit (Fig. 3.5.5c).

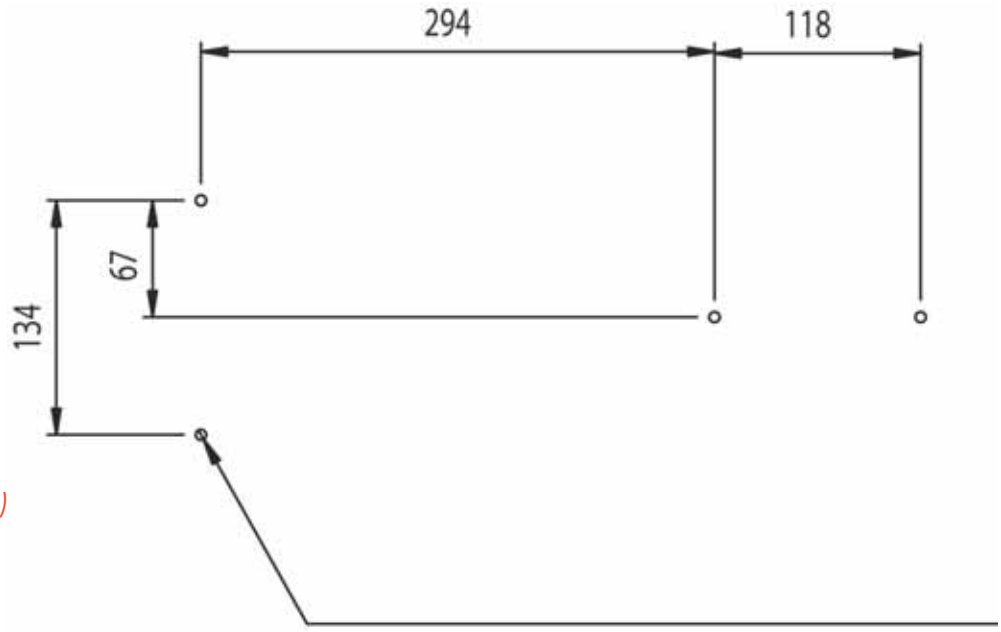
3 – Fix the Remote Unit to the wall and tighten the 4 screw anchors (Fig. 3.5.5d)

4 - Fix the splice holder (not included) inside a splice tray like the one shown in Fig. 3.5.5e (not included).
Make the optical splices and close the splice tray (Fig. 3.5.5f).
Place the splice tray inside a splice box (not included), and mount the splice box beside the Remote Unit. The suggested installation position is side by side to the power supply or

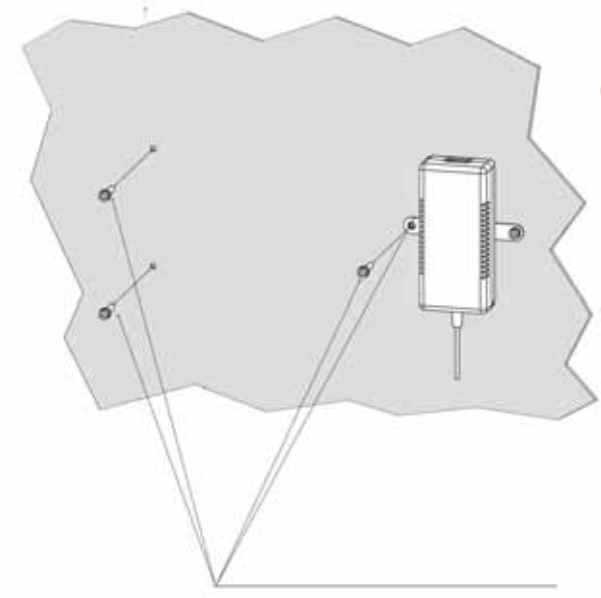


(a)

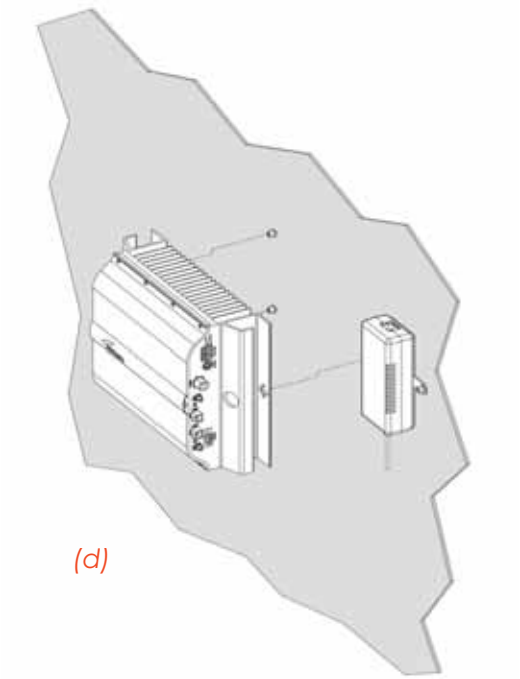
Figure 3.5.5:
Mounting the Case-R2 Remote Unit,
Steps (a) - (c).



(b)

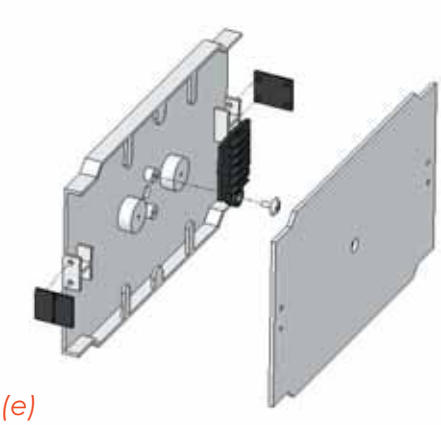


(c)



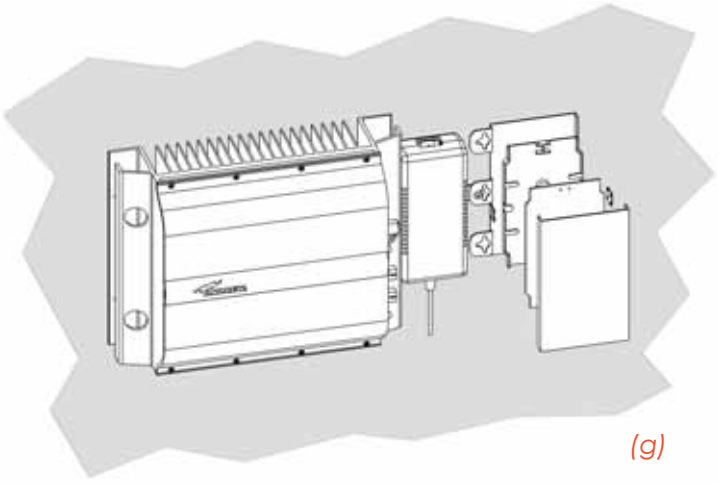
(d)

Figure 3.5.5:
Mounting the Case-R2 Remote Unit,
Steps (d) - (h).

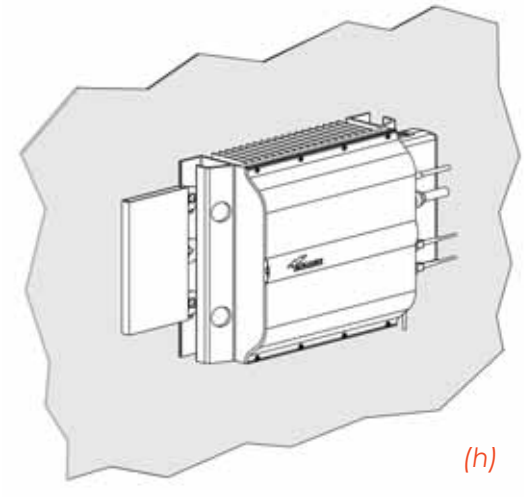


(e)

(f)

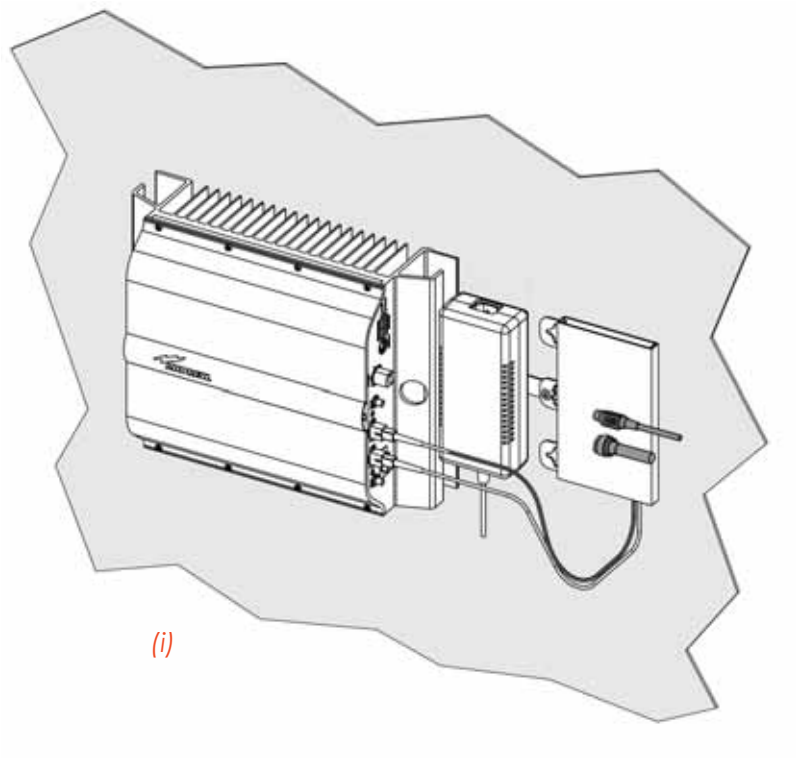


(g)

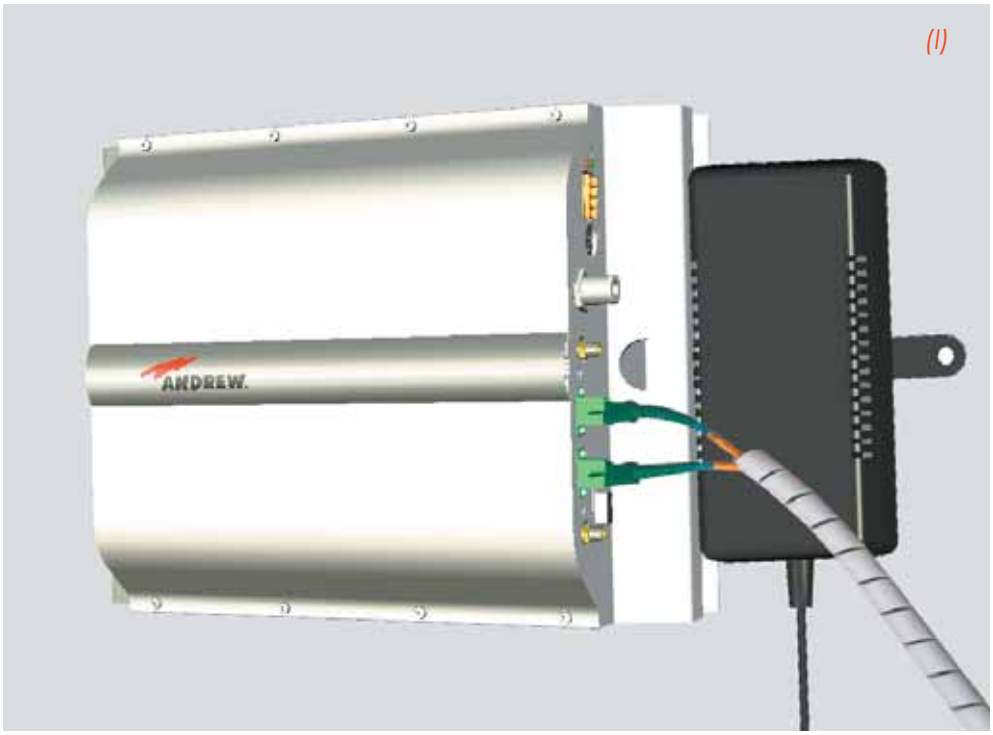


(h)

Figure 3.5.5:
Mounting the Case-R2 Remote Unit,
Steps (i) - (l).



(i)



(l)

to the Remote Unit, using one of their M6 anchors already installed to support the splice box as well (please see Fig. 3.5.5g).
NOTE: Take care not to bend the fibers too much.

5 - Now connect the RF cables, the optical connectors, and the power supply connector to the Remote Unit (Fig. 3.5.5h).
Take care to connect UL and DL fibers properly (Fig. 3.5.5i).
After the Remote Unit has been properly cabled, insert the power plug in the external power supply adapter, so as to connect it to the mains.

6 - A fiber protection can be placed around DL optical fibers (Fig. 3.5.5l).

TFAx Case R2 start-up

Before the Case-R2 Remote Unit is switched on, make sure that:

- the modules hosted in the master unit have been connected each other with RF jumpers, according to the system design
- every TFLN master optical Trx has been connected to its Remote Units
- each Remote Unit has been connected to its coverage antennas

For a correct system start-up, all the Remote Units have to be switched on before the master unit.

Once the Cabinet-R2 Remote Unit has been switched on, its behaviour could be checked by unscrewing the four hexagonal screws (see fig on the sides of the case-F), removing the cover, and looking at the control LEDs. When the system starts-up, their status can be summarised as per the following steps.

1. When the Remote Unit is turned on, both the LEDs turn on for a couple of seconds.
2. After that, the unit green LED remains on (thus indicating proper power supply), while the red LED switches off as soon as the TFLN master unit is turned on (meaning that DL optical power is OK and no alarms are present).
3. Once the TFLN master unit has been switched on, the status of both LEDs have to be the one reported in table 3.5.1. If the red LED remains on, please refer to the troubleshooting section.
4. Once it has been switched on, the Remote Unit starts working correctly. Anyway, in order to be recognized by the supervision management system, it is necessary for the corresponding TFLN master optical TRX to carry out the discovery phase (please refer to Supervision System Manual for more details). During this phase, (whose duration depends on the system complexity, and which can last at max. 4min) the TFLN LED ┌┘ blinks. Do not connect/disconnect any cable or any piece of equipment during the discovery phase! This may result in no identification of the Remote Unit.

Note: if then discovery doesn't start automatically, check through the LMT or the remote supervision whether it has been disabled (refer to LMT or remote Supervision System manuals for further information).

ALARM CODE (TSUN description)	ALARM DESCRIPTION	ACTIVE LED	SUPERVISION PRIORITY LEVEL	ACTION RECOMMENDED	RELÉ PRIORITY LEVEL (subrack)
Antenna DC loop alarm	ALWAYS OK				
DL optical power fail[1]	The optical power received on the DL is too low and can't no more be compensated	RED	MAJOR	Check the DL fibre and the TFLN laser status	MAJOR
AGC out of range[1]	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	WARNING	Clean optical connectors	MINOR
DL RF alarm in Band 1	HW failure on the DL low band RF section	RED	CRITICAL	Return the unit	MAJOR
DL RF alarm in Band 2	HW failure on the DL high band RF section	RED	CRITICAL	Return the unit	MAJOR
DL RF alarm in Band 3 (if present)	HW failure on the DL UMTS band RF section	RED	CRITICAL	Return the unit	MAJOR
External 1 alarm	Alarm on the device connected on dry-contact 1	RED	MAJOR	Check the external device or alarm connection	MAJOR
External 2 alarm	Alarm on the device connected on dry-contact 2	RED	MAJOR	Check the external device or alarm connection	MAJOR
Power supply alarm	UPS HW failure or malfunction. RF is turned OFF	RED	MAJOR	Check the external PSU. If it works properly, return the unit	MAJOR
Internal BUS alarm	A malfunctioning on the digital part involves a fault in monitoring functionalities	RED	CRITICAL	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	MINOR	Check ventilation and environment	MINOR

Table 3.5.2: Description of the alarms of the Case-R and Case R2 Remote Unit, as they are presented by the LMT application or by the Supervision interface

TFAx Case-R or Case-R2 troubleshooting

Faults can be revealed by LEDs on the Remote Unit *(RU)* front panel as well as by LMT or Supervision System (running on the remote supervision unit)

Both LMT and Supervision System provide full information about the device causing the alarm.

As a consequence, troubleshooting procedure can be very immediate when the failure

detection is directly carried out through LMT or Supervision System.
ION-B modules are designed in order to exchange information each other: each RU constantly monitors the optical signal received from its TFLN unit, so as to control optical losses. Table 3.5.2 shows a brief description of the alarms related to a Cabinet R2 Remote Unit, with a reference to the corresponding alerted LEDs and to the actions to be carried out in the case of a fault.

As the table shows, not all the alarms are revealed by the LEDs placed on the Remote Unit control panel: in fact, LEDs reveal only major alarms (i.e., the high priority ones), whereas the minor alarms (i.e., the low priority ones) are revealed only by the LMT software or through the TSUN Supervision System. The minor alarms usually detect critical situations which should be checked so as to avoid future possible system faults.

[1]Note:
Each Remote Unit is provided with an AGC system which comes in after the optical-to-RF conversion. This AGC can correctly compensate optical losses when these are estimated to be <3.5 dB. In case optical losses are > 3.5dB, the LMT application and the ION-B supervision unit will display a "Warning" alarm: the whole system still work, but AGC is near to its borderline levels.
The red LED switches on when the estimated optical losses are >4.5dB, the AGC not being able to compensate these losses any more.

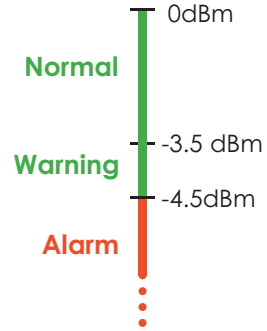


Fig. 3.5.6:
AGC thresholds vs LED alerts

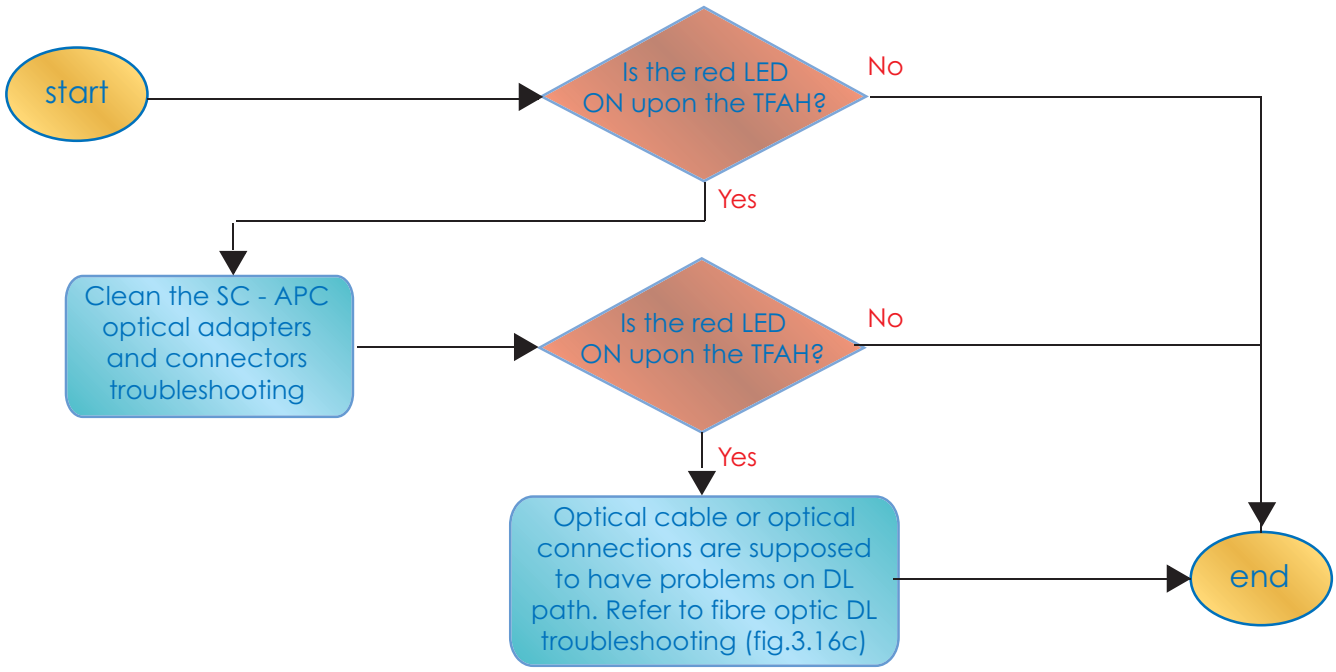


Figure 3.5.7 (a): Flow-chart describing the quick troubleshooting procedure of a TFAx Case R

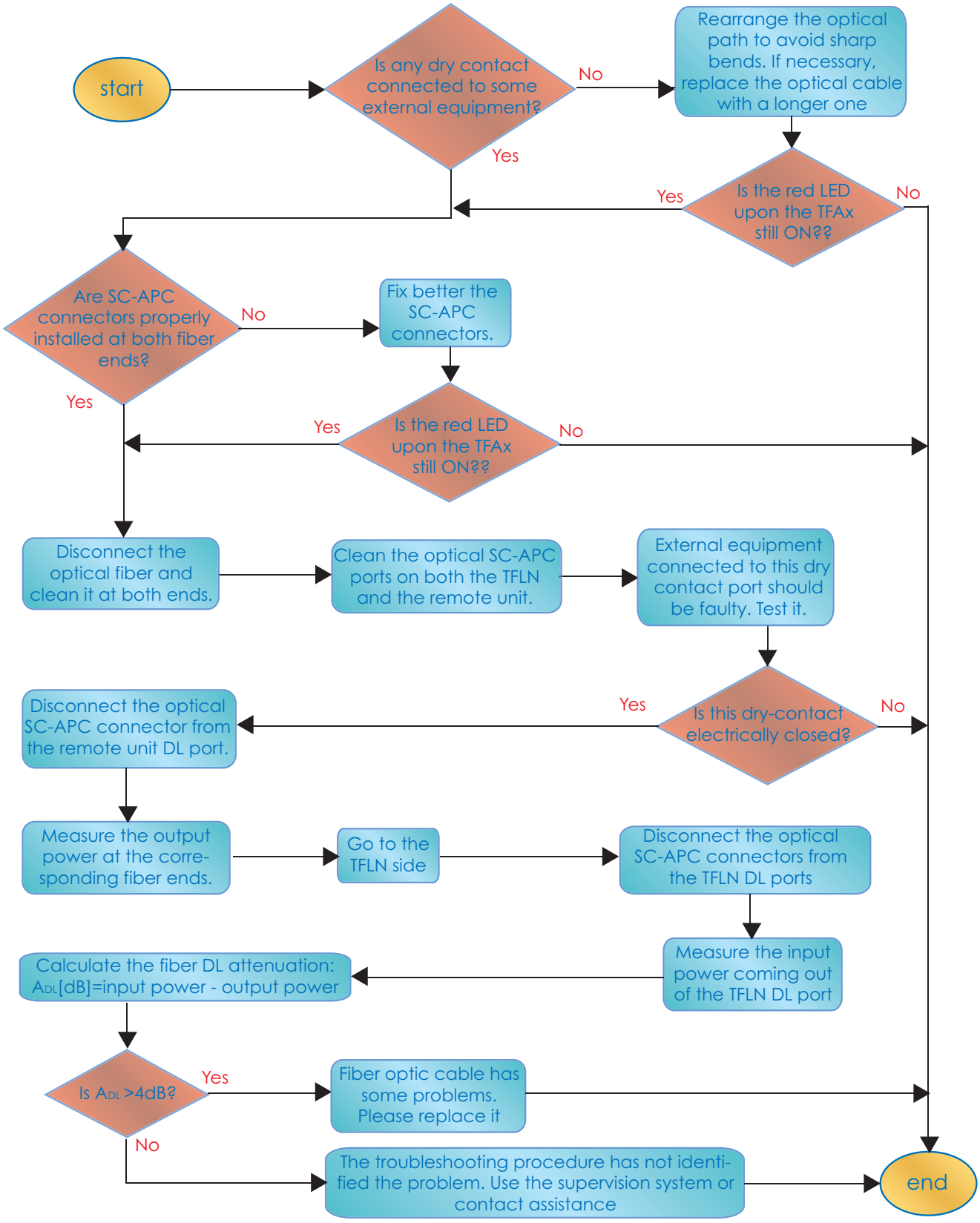


Figure 3.5.7 (b): Flow-chart describing the external alarm troubleshooting on TFAx Case R2

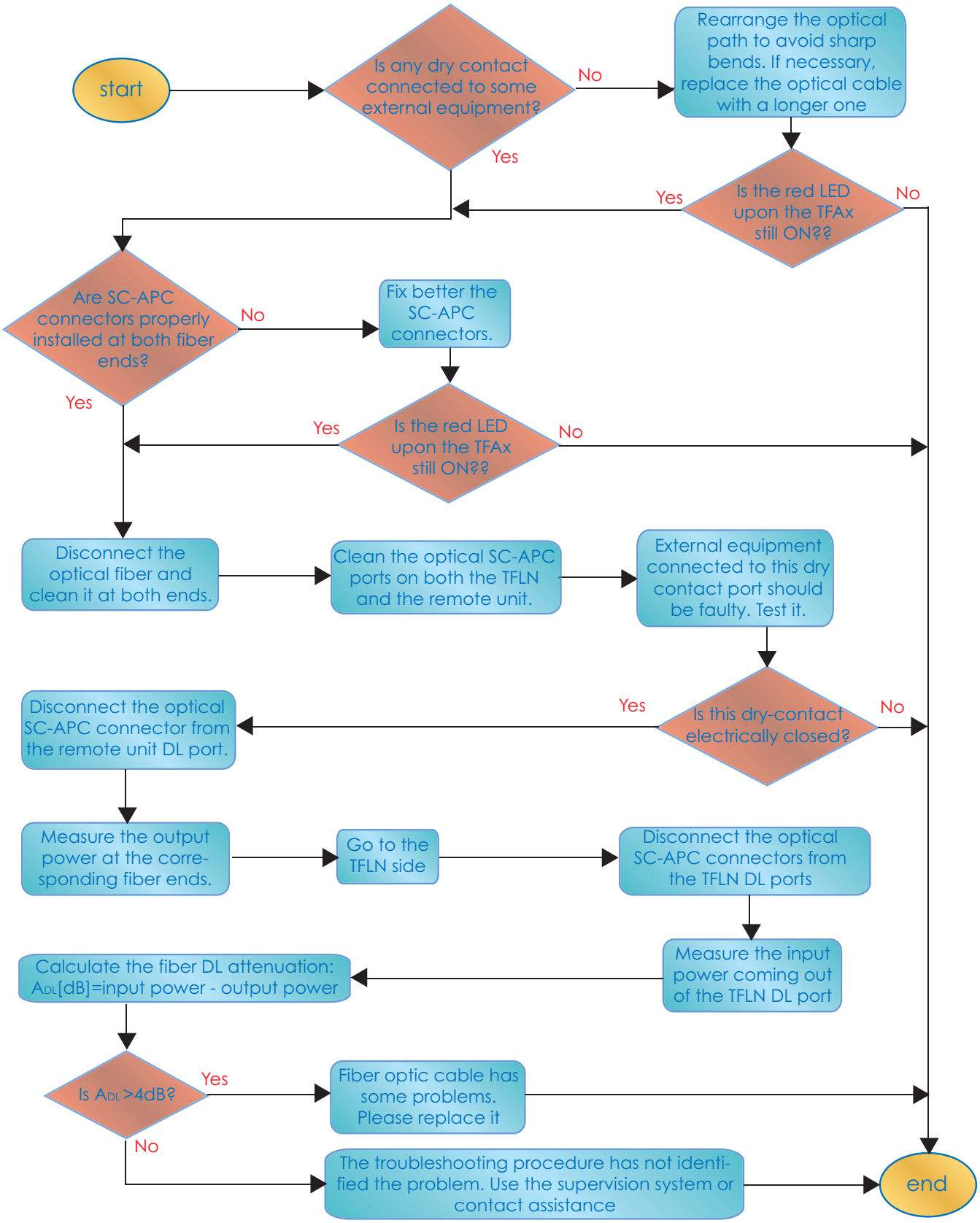


Figure 3.5.7 (c): Flow-chart describing the fiberoptiic troubleshooting

As shown in the previous table, the same red LED switches on to reveal any major failure. Following the troubleshooting procedure reported hereinafter it is possible to better understand what problem occurred.

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 3.5.7a)

In case the red LED is ON, please follow these steps:

1. First of all, clean the optical adapters
2. If the problem still persists, refer to the fibre optic DL troubleshooting to check if optical cables or optical connections have any problem on DL path.
3. If previous actions didn't make the LED switch off replace the unit with a new one or contact for assistance.

Dry-contact troubleshooting

(The following procedure is summarized by the flow-chart in Fig. 3.5.7b)

This procedure should be considered if at least one TFAx dry-contact is connected to any external equipment. If not, return to main troubleshooting procedure.
These steps aim to detect any failure inside external equipment or dry-contact ports. If the dry-contacts aren't able to reveal any equipment malfunctions or port failures, then return to the main troubleshooting procedure.
For any dry-contact that is connected to external equipment, follow these steps:

1. Disconnect it, and check the TFAx LED status after the disconnection.
2. If the red LED has switched off, any external equipment that is connected to the dry contact port is probably faulty. Please test it.
3. If the TFAx red LED still remains on after the disconnection, measure the voltage between the terminals of the dry contact port.
    a. If the terminals are electrically closed, the dry-contact port is faulty. Contact the manufacturer for assistance.
    b. If the terminals are open, this means neither the analysis of the present dry contact nor the one of its external equipment has revealed failures. Re-connect the present dry contact port to its external equipment. If the TFAx has any other unchecked dry-contacts connected to external equipment, apply the whole procedure (i.e. steps 1-3) to this new port

Fibre optic DL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 3.5.7c)

1. Check if there is any point where fibre experiences a short radius of curvature. In this

case, rearrange the optical path in order to avoid sharp bends (if necessary, replace the optical cable with a longer one). If TFLN red LED switches off, troubleshooting has been successfully carried out. Otherwise, follow next steps.

2. Check if SC-APC connectors are properly installed at both fibre ends. In case they are not, fix better SC-SPC connectors to adapters. If TFLN red LED switches off, troubleshooting has been successful. Otherwise, follow next steps.
3. Disconnect the optical fibre and clean it better at both ends then clean the SC-APC ports on both the TFLN and the Remote Unit. Re-connect the fibre to relevant ports after cleaning. If it doesn't made TFLN red LED switch off, follow next steps.
4. Disconnect the optical SC-APC connector from Remote Unit DL port, and measure the output power P_{OUT}(DL) at the corresponding fibre end. Then, go to the TFLN side, disconnect the optical SC-APC connector from TFLN DL port and measure the input power P_{IN}(DL) coming out of the TFLN DL port. Calculate the DL fibre attenuation A_{DL} as A_{DL} [dB] = P_{IN}(DL) – P_{OUT}(DL)
    a. If A_{DL} > 4dB, then the fibre optic cable has some problems. Replace it with a new one.
    b. If A_{DL} < 4dB troubleshooting procedure has not identified the problem. Refer to Supervision System or contact assistance.

3.7. Case F Remote Unit

Dimensions and Weight

Dimensions: mm. 564 x 255 x 167
(inches 21.5 x 10 x 8.1)

Weight: please refer to the Remote Unit dedicated bulletin in order to know the updated data about the weight of your case-F Remote Unit.

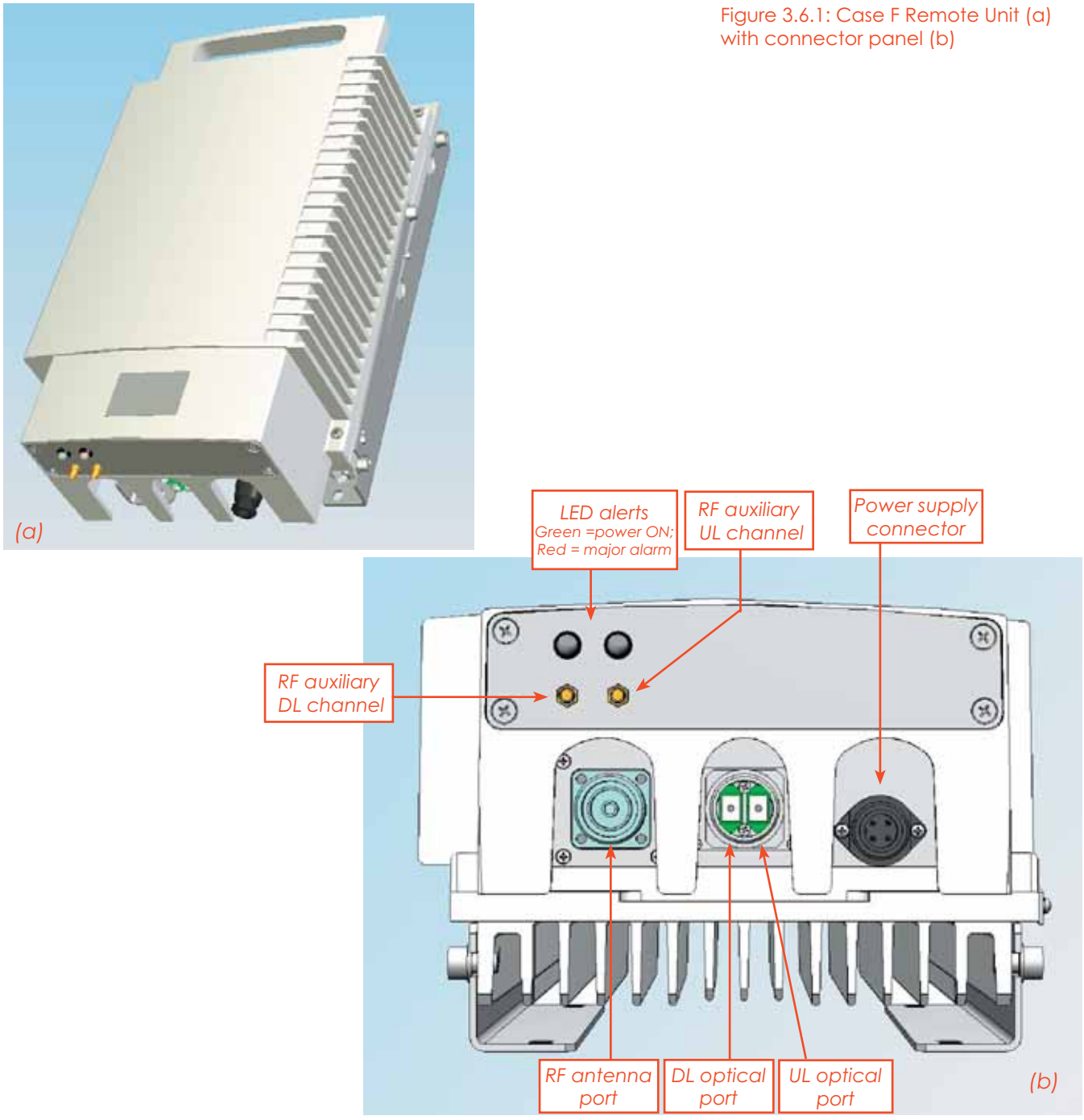


Figure 3.6.1: Case F Remote Unit (a) with connector panel (b)

RF ports:

- 1 RF antenna port, transmitting/receiving signals to/from distributed antennas. This RF antenna port is a duplexed N-female connectors. The port can be connected to the antenna either directly (ie. through RF jumper cables) or through splitters, thus allowing more antennas to be fed.
- 1 RF auxiliary input and 1 RF auxiliary output (designed to receive and transmit additional signals). Auxiliary input and output ports are SMA-female connectors.

Optical ports:

- 1 optical output port, transmitting UL signals to TFLN master optical TRX;
- 1 optical input port, receiving DL signals from TFLN master optical TRX.

Visual alarms:

Two control LEDs are provided on the Case-F upper side (fig. 3.6.2).
The green LED describes the power supply status, while the red LED describes the major Remote Unit failures (Table 3.6.1).

Figure 3.6.2: LED panel on the Case-F Remote Unit

Led colour	Meaning
Red	Low optical power at DL input and/or RF amplifier failure
Green	Power supply OK

Table 3.6.1: LED panel on the Case-F Remote Unit

External alarms

Case F architecture does not provide any external alarms control.

Power supply:

Case-F Remote Unit is available in two versions: one feeded by universal mains (85 to 265 Vac), the other by negative power supply (-72 to -36 Vdc): in figure 3.6.3, the 85/220 Vac connector and the -72/-36 Vdc connector are described. Power feeder is always internal. The power cable is always included in the Case-F Remote Unit kit.

85/264 Vac: Connector
PE: ground
1: N
2: L

-36/-72 Vdc: Connector
4: 0V
6: -48V

Figure 3.6.3: Description of the 85/264 Vac inlet (a)
and of the -36/-72 Vdc inlet (b) on a Case-F Remote Unit

Warnings (to be read before Remote Units are installed)

Dealing with optical output ports

The Case-F Remote Unit contains semiconductor lasers. Invisible laser beams may be emitted from the optical output ports. Do not look towards the optical ports while equipment is switched on.

Choosing a proper installation site for the Remote Units

- Case-F Remote Units have to be installed as close as possible to the radiating antennas, in order to minimize coaxial cable length, thus reducing downlink power loss and uplink noise figure.
- When positioning the Case-F Remote Unit, pay attention that the placing of related antennas should be decided in order to minimize the Minimum Coupling Loss (MLC), so as to avoid blocking.
- The Case-F Remote Unit is intended to be fixed on walls or other flat vertical surfaces.

Handling optical connections

- When inserting an optical connector, take care to handle it so smoothly that the optical fibre is not damaged. Optical fibres are to be single-mode (SM) 9.5/125µm.
- Typically, ION-B equipment is provided with SC-APC optical connectors (other connectors may be provided on request). Inserting any other connectors will result in severe damages.
- Do not force or stretch the fibre pigtail with radius of curvature less than 5cm. See rightward figure for optimal fibre cabling.
- Remove the adapter caps only just before making connections. Do not leave any SC-APC adapter open, as they attract dirt. Unused optical connectors must always be covered with their caps.

- Do not touch the connector tip. Clean it with a proper tissue before inserting each connector into the sleeve. In case connector tips need to be cleaned, use pure ethyl alcohol.

TFAx Case-F installation

Each case-F Remote Unit kit includes:

- 1 Case-F Remote Unit;
- 1 power supply cable (85 to 264 Vac or -48Vdc, depending on the power supply which has been chosen);
- 1 pair of mounting plates;
- 1 screw kit, including four hexagonal-head screws and a torque key.

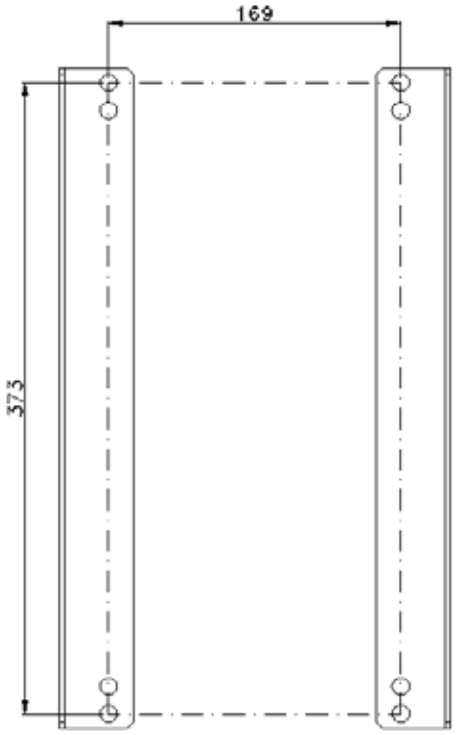
The operations which need to be carried out in order to perform a proper installation of the Case-F Remote Unit are hereby described:

1- Drill the wall to install four M8 screws anchors (not included) as indicated by the installation drawing shown in fig. 3.6.4a. Fix the two mounting plates to the wall by firmly screwing the anchors.

2 –Take two of the hexagonal-head screws included in the kit, and fasten them at the top of the case-F unit (fig. 3.6.4b, step "b,1") by using the torque key: while fastening the screws, take care to leave the space required to hang the case-F to the plates (fig. 3.6.4b, step "b,2").. Fasten the screws further only after hanging the case-F. Then take the other two hexagonal screws (included) and use them to fasten the bottom sides of the unit to the bottom side of the plates (fig. 3.6.4b, step "b,3").

3 – Fix a splice holder (not included) inside the proper splice tray (not included, fig. 3.6.4c). Makes the splices between the fiberoptics patchcords coming from the Case-F Remote Unit and the fiberoptics cables which go to the local units. House the optical splices inside the splice holder. Close the splice tray. During these operations, please take care not to bend the fibres too much. Fix the splice tray inside a splice box (not included), and mount the splice box beside the Remote Unit.

4 - Use the torque key in order to loose the four screws fixing the cover (fig. 3.6.4d), and open the unit.
Connect the antenna RF cable to the RF antenna port. Connect the UL and DL optical connectors to the corresponding UL and DL adapters on the unit.
Connect the Power cable to the power connector. In case the power cable has been connected to the mains, both the green and the red LEDs should turn on. The green LED will remain on to indicate that the unit is powered on, while the RED led will turn off



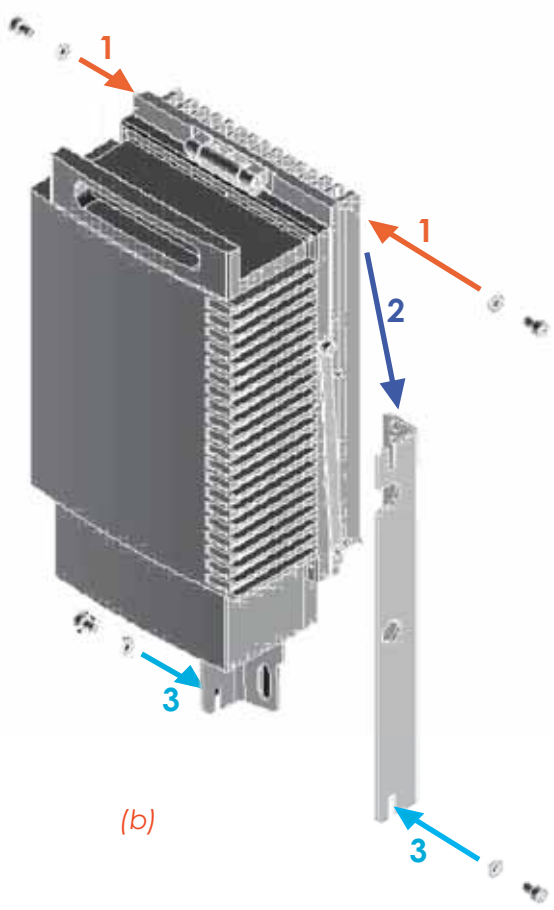
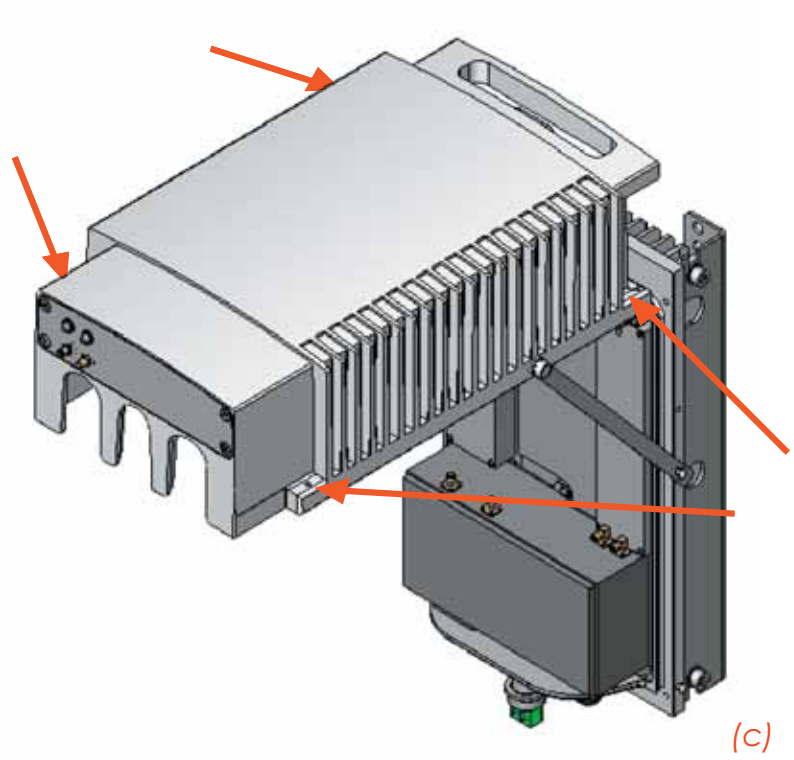
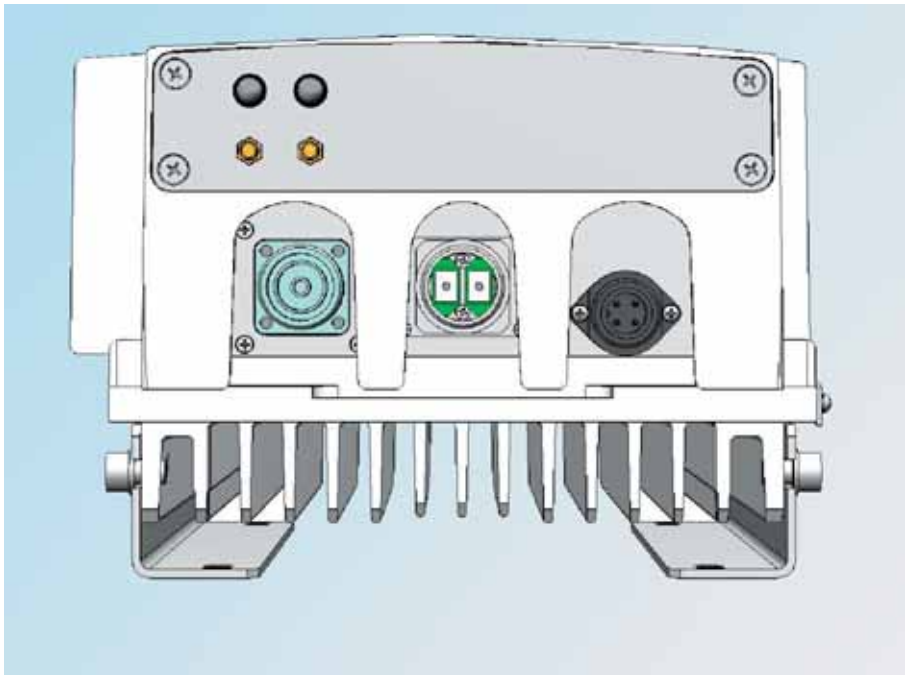


Figure 3.6.4:
Mounting the Case-F Remote Unit
Steps (a), (b)



(c)

Figure 3.6.4:
Mounting the Case-F Remote Unit
Steps (c)-(d)



(d)

as soon as the local unit will be switched on (for further details about the start-up of the whole system, please refer to the section "TFAx Case F start-up").

5 - Close the unit, and fasten the 4 screws shown in fig. 3.6.4c by using the torque key.

TFAx Case F start-up

Before the Case-F Remote Unit is switched on, make sure that:

- the modules hosted in the master unit have been connected each other with RF jumpers, according to the system design
- every TFLN master optical TRX has been connected to its Remote Units
- each Remote Unit has been connected to its coverage antennas

For a correct system start-up, all the Remote Units have to be switched on before the master unit.
Once the Case-F Remote Unit has been switched on, its behaviour could be checked by unscrewing the four hexagonal screws (see fig on the sides of the case-F), removing the cover, and looking at the control LEDs. When the system starts-up, their status can be summarised as per the following steps.

1. When the Remote Unit is turned on, both the LEDs turn on for a couple of seconds.
2. After that, the unit green LED remains on (thus indicating proper power supply), while the red LED switches off as soon as the TFLN master unit is turned on (meaning that DL optical power is OK and no alarms are present).
3. Once the TFLN master unit has been switched on, the status of the LEDs is described by Table 3.6.1. If the red LED remains on, please refer to the troubleshooting section.
4. Once it has been switched on, the Remote Unit starts working correctly. Anyway, in order to be recognized by the supervision management system, it is necessary for the corresponding TFLN master optical TRX to carry out the discovery phase (please refer to Supervision System Manual for more details). During this phase, (whose duration depends on the system complexity, and which can last at max. 4min) the TFLN LED " ⌐┘ " blinks. Do not connect/disconnect any cable or any piece of equipment during the discovery phase! This may result in no identification of the Remote Unit.

Note: if then discovery doesn't start automatically, check through the LMT or the remote supervision whether it has been disabled (refer to LMT or remote Supervision System manuals for further information).

TFAx Case F troubleshooting

Faults can be revealed by LEDs on the Remote Unit (RU) front panel as well as by LMT or Supervision System (running on the remote supervision unit)

Both LMT and Supervision System provide full information about the device causing the alarm. As a consequence, troubleshooting procedure can be very immediate when the failure detection is directly carried out through LMT or Supervision System.
ION-B modules are designed in order to exchange information each other: each RU constantly monitors the optical signal received from its TFLN unit, so as to control optical losses. Table 3.6.2 shows a brief description of the alarms related to a Case L Remote Unit, with a reference to the corresponding alerted LEDs and to the actions to be carried out in the case of a fault.

As this table shows, not all the alarms are revealed by the LEDs placed on the Remote Unit control panel: in fact, LEDs reveal only major alarms (i.e., the high priority ones), whereas the minor alarms (i.e., the low priority ones) are revealed only by the LMT software or through the TSUN Supervision System. The minor alarms usually detect critical situations which should be checked so as to avoid future possible system faults.

Note:
Each Remote Unit is provided with an AGC system which comes in after the optical-to-RF conversion. This AGC can correctly compensate optical losses when these are estimated to be <3.5 dB. In case optical losses are > 3.5dB, the LMT application and the ION-B supervision unit will display a "Warning" alarm: the whole system still work, but AGC is near to its borderline

ALARM CODE (TSUN description)	Alarm Description	Active LED	Supervision Priority Level	Action Recommended	RELE' Priority level
DL optical power	The DL received optical power is too low and can no more be compensated by AGC 1	RED	MAJOR	Check the DL fibre and the TFLN laser status	MAJOR
AGC out of range	The DL received optical power experiences a loss > 3dB, which nevertheless can still be compensated 1	NONE	WARNING	Clean optical connectors	MINOR
DL low alarm in Band 1	HW failure on the DL RF low band	RED	CRITICAL	Return the unit	MAJOR
DL high alarm in band 2	HW failure on the UL RF low band	RED	CRITICAL	Return the unit	MAJOR
Power supply alarm	UPS HW failure or malfunction. RF is turned OFF	RED	MAJOR	Return the unit	MAJOR
Internal BUS alarm	A malfunctioning on the digital part involves a fault in monitoring functionalities	RED	CRITICAL	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	MINOR	Check ventilation and environment	MINOR

Table 3.6.2 (a): Description of the alarms of the TFAx Case F Remote Unit, as they are reported by LMT application or Supervision Interface.

levels.
The red LED switches on when the estimated optical losses are >4.5 dB, the AGC not being able to compensate these losses any more.

As shown in the previous table, the same red LED switches on to reveal any major failure. Following the troubleshooting procedure reported hereinafter it is possible to better understand what problem occurred.

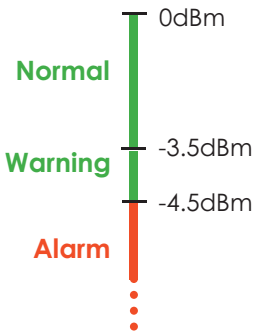


Fig. 3.5.6:
AGC thresholds vs LED alerts

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 3.6.6a)

In case the red LED is ON, please follow these steps:

1. First of all, clean the optical adapters
2. If the problem still persists, refer to the fibre optic DL troubleshooting to check if optical cables or optical connections have any problem on DL path.
3. If previous actions didn't make the LED switch off replace the unit with a new one or contact for assistance.

Fibre optic DL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 3.6.6b)

1. Check if there is any point where fibre experiences a short radius of curvature. In this case, rearrange the optical path in order to avoid sharp bends (if necessary, replace the

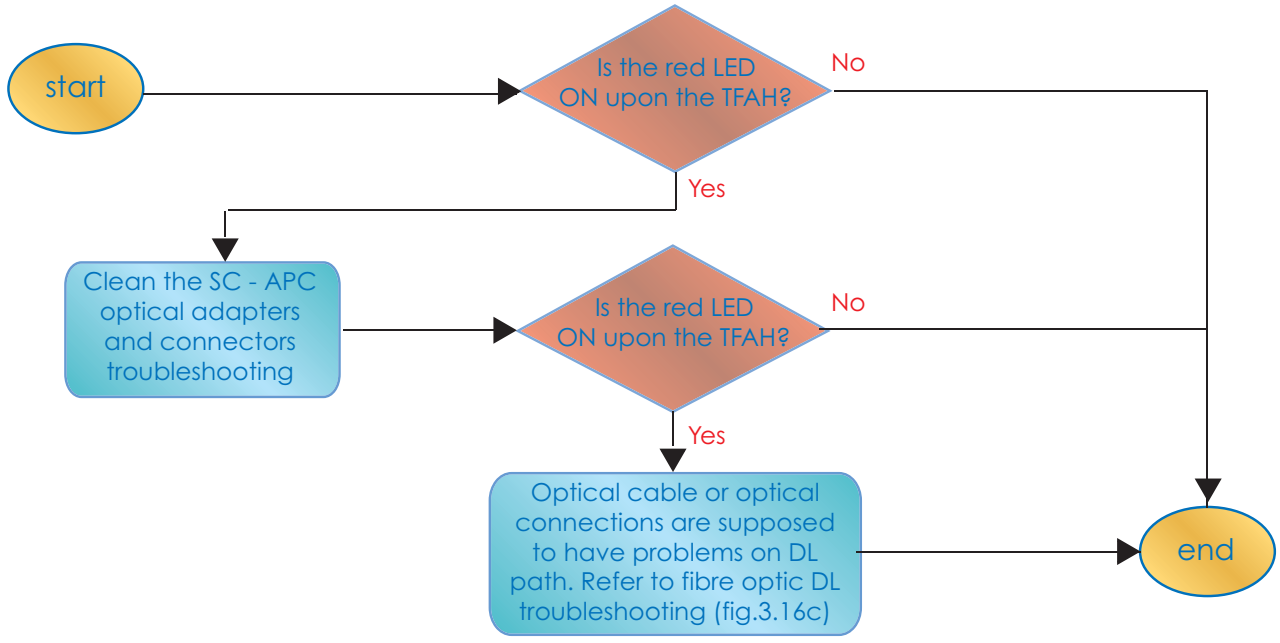


Figure 3.6.6 (a): Flow chart describing the quick troubleshooting procedure for the Case F Remote Unit

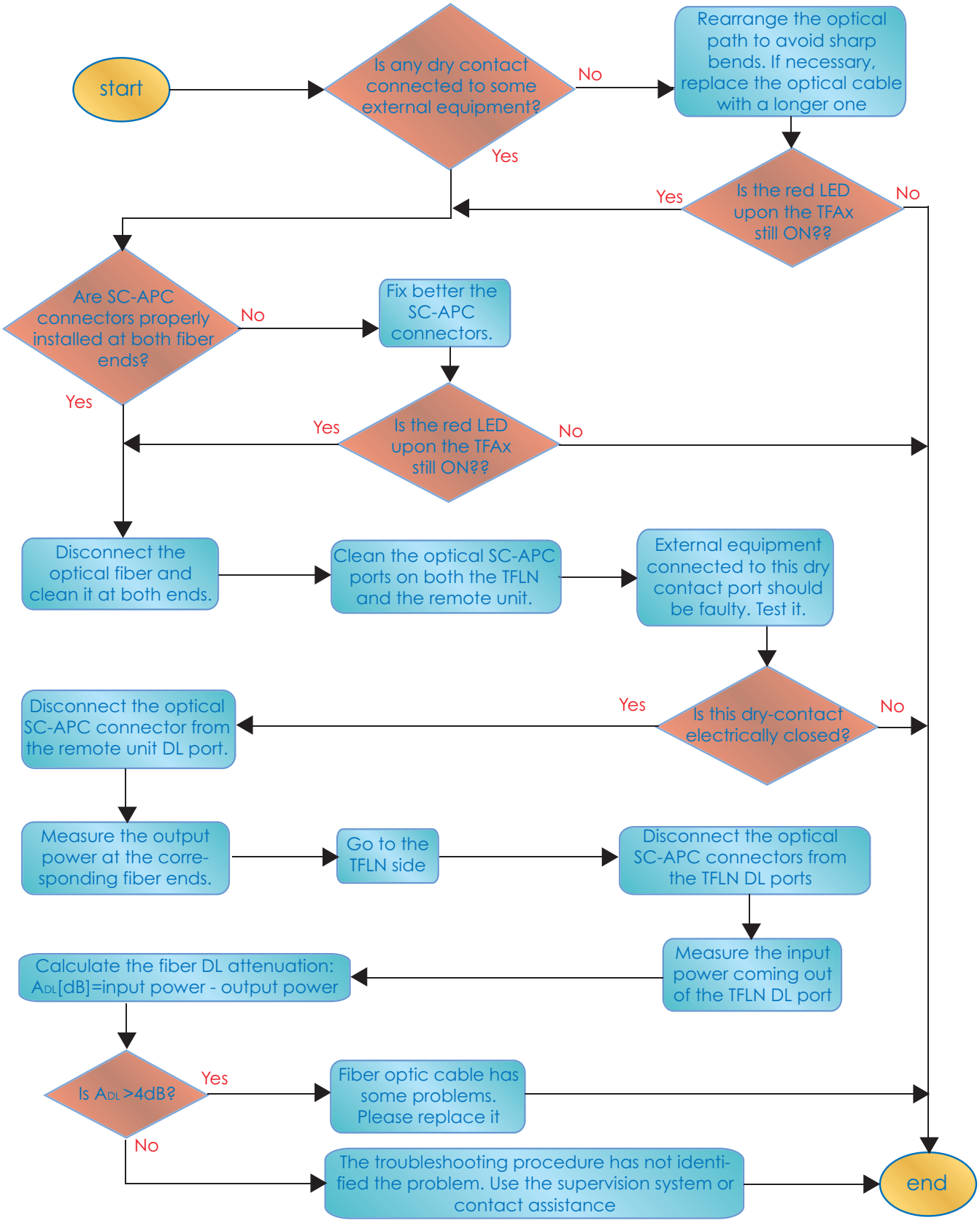


Figure 3.6.6 (b): Flow chart describing the fiber DL troubleshooting

optical cable with a longer one). If TFLN red LED switches off, troubleshooting has been successfully carried out. Otherwise, follow next steps.

2. Check if SC-APC connectors are properly installed at both fibre ends. In case they are not, fix better SC-SPC connectors to adapters. If TFLN red LED switches off, troubleshooting has been successful. Otherwise, follow next steps.
3. Disconnect the optical fibre and clean it better at both ends then clean the SC-APC ports on both the TFLN and the Remote Unit. Re-connect the fibre to relevant ports after cleaning. If it doesn't made TFLN red LED switch off, follow next steps.
4. Disconnect the optical SC-APC connector from Remote Unit DL port, and measure the output power POUT(DL) at the corresponding fibre end. Then, go to the TFLN side, disconnect the optical SC-APC connector from TFLN DL port and measure the input power PIN(DL) coming out of the TFLN DL port. Calculate the DL fibre attenuation ADL as ADL [dB] = PIN(DL) – POUT(DL)
    a. If ADL > 4dB, then the fibre optic cable has some problems. Replace it with a new one.
    b. If ADL < 4dB troubleshooting procedure has not identified the problem. Refer to Supervision System or contact assistance.

4. Rack-based Master Unit

4.1. TPRNx4 Subrack

Major TPRN features

The TPRNx4 is a 19"subrack where all the ION-B plug-in modules can be inserted. ION-B equipment provides a wide variety of these sub-rack models differentiated according to power supply. Each one is provided with:

- 12 free slots, each with Height=4HE, Width=7TE
- Power supply 220 Vac or -48 Vdc
- Locally or remotely connectable through:
    a. RS232 serial port
    b. RS485 two-wire bus
    c. sub-D 15 pin male-connector
- Internal microcontroller for I2CBUS alarm collection
- Manual reset button, able to re-initialize both the inserted modules and the TPRN microcontroller
- Manual stand-by button, able to re-initialize the inserted modules, while keeping the TPRN microcontroller working.

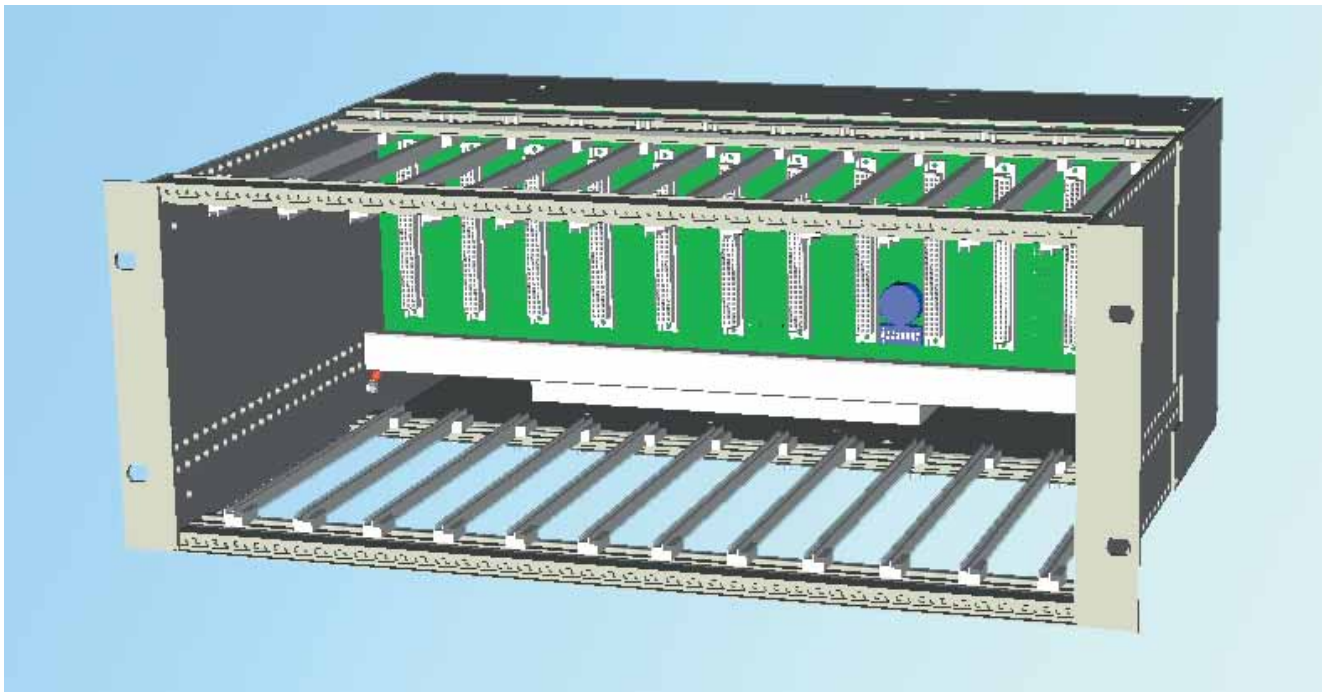


Figure 4.1.1 : TPRN subrack

TPRN models

All of the available TPRN sub-racks are described briefly on the following pages:

Passive sub-rack (TPRN04)

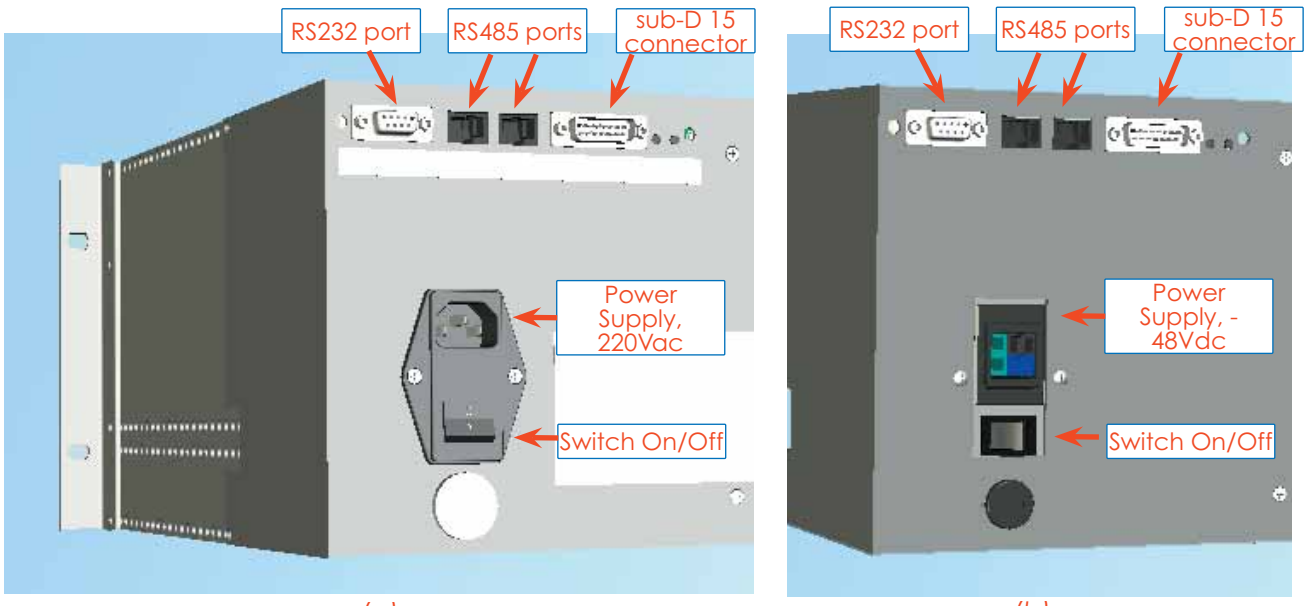
- TPRN04 is a passive sub-rack. It cannot supply power to any inserted module, and therefore is designed to host passive modules only. It can be useful in a multi-sub-rack system, in case the customer decides to put all the active modules in an active sub-rack, to be chosen among the following:

220 Vac powered sub-racks (TPRN14 / TPRN24)

- TPRN14 is an active sub-rack designed to be fed through 220 Vac universal mains. Both the connector for the 220 Vac power supply and the communication ports are placed on the rear of sub-rack. The 220 Vac power supply is not redundant (ie, no spare adapter is provided).
- TPRN24 is an active sub-rack designed to be fed through 220 Vac universal mains. Both the connector for the 220 Vac power supply and the communication ports are placed on the rear of sub-rack, and the 220 Vac power supply is redundant: i.e., a spare adapter guarantees the correct system operations even if the main 220Vac adapter has a breakdown.

-48Vdc powered sub-rack (TPRN34)

- TPRN34 is an active sub-rack designed to be fed through a –48 Vdc negative supply. Both the connector for the -48Vdc power supply and the communication ports are placed on the rear of the sub-rack.



(a) (b)

Figure 4.1.2: Rear view of the TPRN subrack with 220Vac power supply (a) and with -48Vdc power supply (b)

TPRN power supply

All the TPRN models refer to one of the following power supplies.

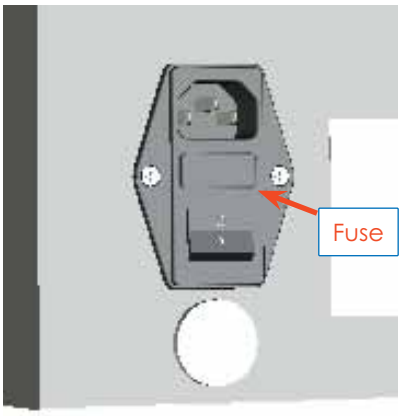


Figure 4.1.3: 85 to 264Vac inlet

Universal mains

(85 to 264Vac, 50/60Hz).

This connector is mounted on the TPRN back panel, both for the redundant version and the simple one. A ground terminal and a couple of fuses are also included. Fuses must be replaced in case of failure (if it happens, the failure is detected by the Supervision System).

-48 Vdc

(-72 to -36 Vdc)

This connector is mounted on the back panel of the TPRN. A fuse is provided underneath the –48 Vdc connector, and must be replaced in case of failure (if it happens, the failure is detected by the Supervision System).

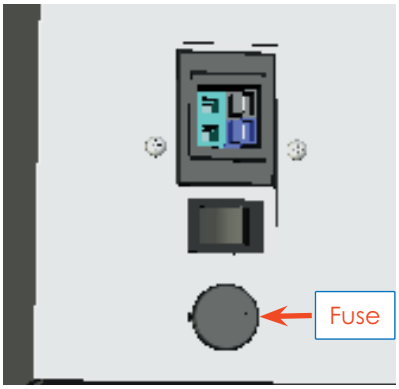


Figure 4.1.4: -48Vdc inlet

Whichever power supply is chosen (85 to 264 Vac or -72 to -36 Vdc) an additional external ground terminal is provided on the rear of the TPRN (Fig. 4.1.5).
The external power supply (220Vac or -48Vdc) is

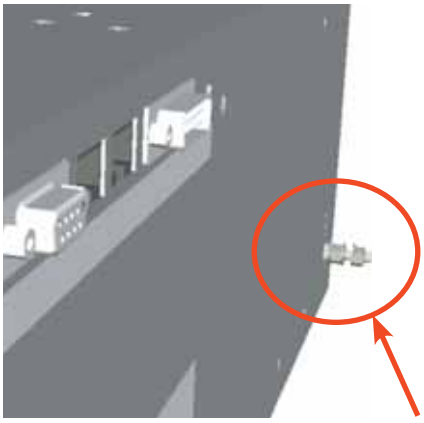
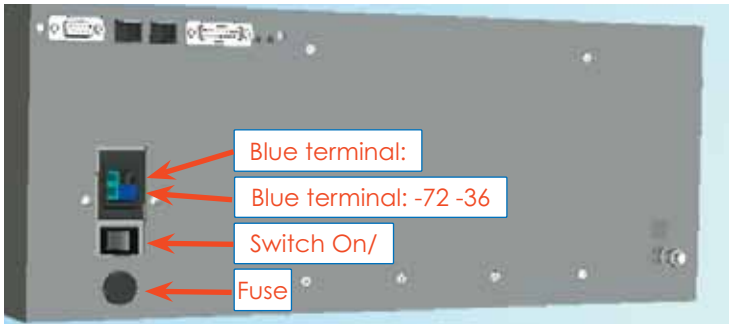


Figure 4.1.5: Ground connector

converted to a +12Vdc voltage, feeding the active modules inserted into the TPRN.

Figure 4.1.6: Rear view of the TPRN subrack with -48Vdc power supply



TPRN ports

The TPRN sub-rack is provided with a set of I/0 ports which allows the connection to any external device.

RS232 serial port

The RS232 serial port can be used to connect the TPRN sub-rack to the remote supervision unit or to a laptop running LMT software. Please note that a standard RS232 cable is needed.

Baud rate [bps]	Dip-switch 5
9600	OFF
19200	ON

Table 4.1.1: Setting the RS232 baud rate through the dip-switch 5

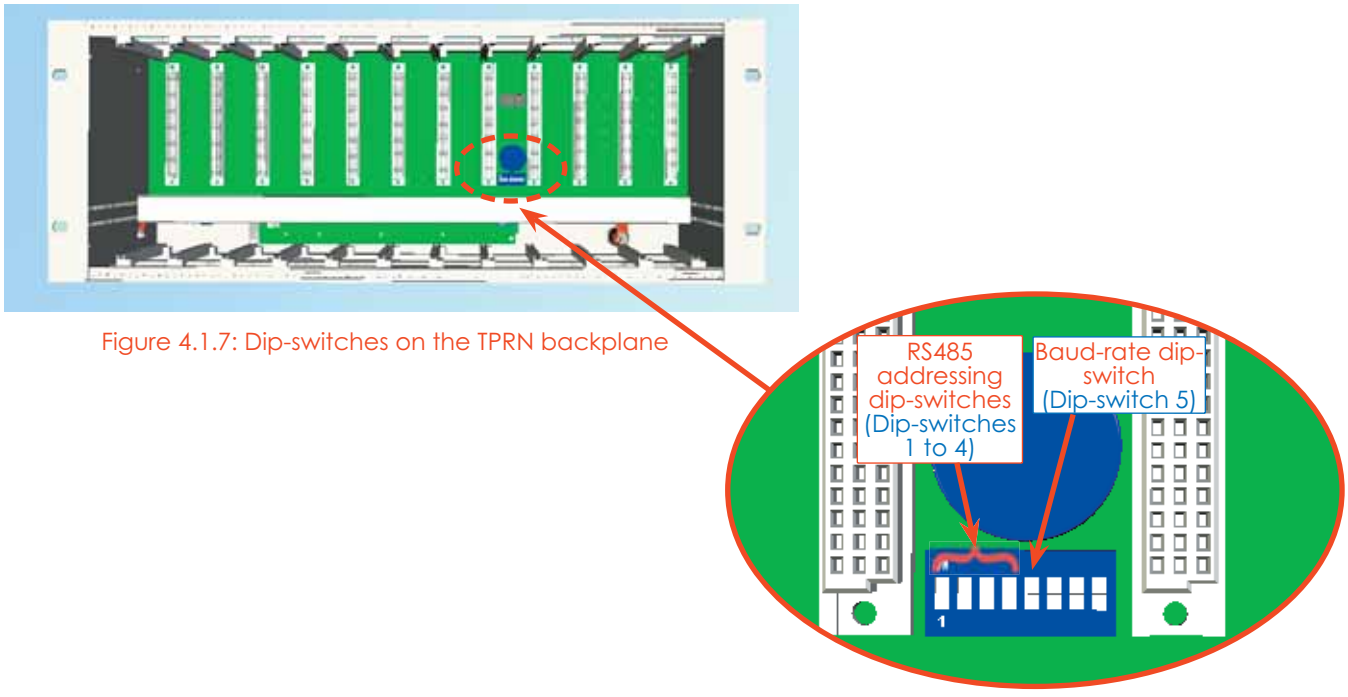


Figure 4.1.7: Dip-switches on the TPRN backplane

The connection baud rate can be set to 9600bps or 19200bps, by properly setting the dip-switch 5 standing on the interior TPRN backplane (fig. 4.1.7). The baud rate setting through dip-switch 5 is shown in Table 4.1.1.
Whichever baud rate you choose through dip-switch 5, remember that:

- the same RS232 connection speed must be set up on the remote supervision unit
- the baud rate which is selected through the dip-switch 5 sets the connection speed for both the RS232 port and the RS485 port as the TPRN uses both ports with the same rate.

RS485 port

The RS485 port consists of two RJ45 connectors, which can both work as input or output ports towards a RS485 bus.
This RS485 bus has to be used in order to connect a multi sub-rack system to the remote supervision unit. In this case:

- the TPRN sub-racks have to be connected to one another via RS485 bus in a daisy chain;
- In order to monitor the whole system, the remote supervision unit has to be connected to one of the TPRN sub-racks through RS232 port.

Before connecting the TPRN sub-racks belonging to a multi-sub-rack system, remember to assign an exclusive binary address to each one. This is essential in order to allow the Supervision System recognize the different master units without any conflicts.

The binary address assignment can be done through dip-switches 1,2,3,4, which are on the interior TPRN backplane (see Figure 4.1.7). A list of correspondences between the addresses and the dip-switches is provided in Table 4.1.3: simply note that dip-switch 1 is the least significant binary digit, while dip-switch 4 is the most significant one.

The baud rate of the RS485 ports is the same as the RS232 port as per the dip-switch 5 setting.

Whichever baud rate you choose, remember that:

- the same RS485 connection speed has to be set up on for the entire connected device (TPRN sub-racks or TSUN remote supervision unit);
- the baud-rate which is selected through the dip-switch 5 sets the connection speed for both the RS485 port and the RS232 port.

Sub-D 15 poles male connector

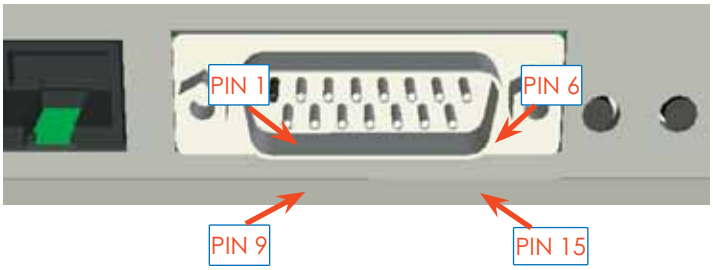


Figure 4.1.8: sub-D 15 poles male connector

The TPRN sub-rack provides sub-D 15 poles male connector, shown in Fig. 4.1.5

As highlighted in Table 4.1.4, this connector provides:

- 4 opto-isolated input ports which can be used to reveal any failure condition on external

Address (Dec)	Address (Bin)	Dip-switch 1	Dip-switch 2	Dip-switch 3	Dip-switch 4
1	0001	ON	OFF	OFF	OFF
2	0010	OFF	ON	OFF	OFF
3	0011	ON	ON	OFF	OFF
4	0100	OFF	OFF	ON	OFF
5	0101	ON	OFF	ON	OFF
6	0110	OFF	ON	ON	OFF
7	0111	ON	ON	ON	OFF
8	1000	OFF	OFF	OFF	ON
9	1001	ON	OFF	OFF	ON
10	1010	OFF	ON	OFF	ON
11	1011	ON	ON	OFF	ON
12	1100	OFF	OFF	ON	ON
13	1101	ON	OFF	ON	ON
14	1110	OFF	ON	ON	ON
Reserved	1111	ON	ON	ON	ON

Table 4.1.3: Dip-switches address settings

PIN	Name	Meaning
1	Ground	It is a ground terminal for digital inputs, i.e. for pin 2, 3, 9, 10.
2	Digital input n.1 (SW assignable)	This port can be used to monitor external equipment status. Once a default working status has been assigned (through the Supervision System) to this input port, any change is detected as a failure signal.
3	Digital input n.2 (SW assignable)	This port can be used to monitor external equipment status. Once a default working status has been assigned (through the Supervision System) to this input port, any change is detected as a failure signal.
4	Disconnected pin	No meaning
5,6	Summary of major alarms	These pins present an open circuit if a major alarm is active on the TPRN sub-rack or on any module hosted in it.
7,8	Summary of minor alarms	These pins present an open circuit if a minor alarm is active on the TPRN sub-rack or on any module hosted in it.
9	Digital input n.3 (SW assignable)	This port can be used to monitor external equipment status. Once a default working status has been assigned (through the Supervision System) to this input port, any change is detected as a failure signal.
10	Digital input n.4 (SW assignable)	This port can be used to monitor external equipment status. Once a default working status has been assigned (through the Supervision System) to this input port, any change is detected as a failure signal.
11	Disconnected pin	No meaning
12,13	Digital output n.1 (SW assignable)	These pins are terminals of an output port (output relay 1), which can be driven through the Supervision System. The output port can be set to “open” or “close” condition. These 2 statuses can be used to pilot any external device connected to subD-15 connector.
14,15	Digital output n.2 (SW assignable)	These pins are terminals of an output port (output relay 2), which can be driven through the Supervision System. The output port can be set to “open” or “close” condition. These 2 statuses can be used to pilot any external device connected to subD-15 connector.

Table 4.1.4: Functional description of pins provided by sub-D male connector

TSUN Alarm Codedescription)	Alarm Description	Active LED	Supervision Priority Level	Action Recommended	RELÉ Priority
Redundant supply active (only for redundant power supply versions)	Backup power supply activated	YELLOW	MAJOR	Return the unit	MINOR
Power Supply alarm	There is a degradation on the power supply provided to the boards	RED	MAJOR	Return the unit	MAJOR
I2CBUS bus error	Internal I2CBUS communication malfunction	YELLOW	CRITICAL	Check if the fault is on the unit (see Supervision System). If not, return the unit	MINOR
Temperature alarm	Over-temperature alarm	YELLOW	MINOR	Check ventilation and environment	MINOR
Aux input alarm nr0	The device connected to the input alarm port 0 caused an alarm condition	RED	CRITICAL	Check the status of the connected device	-
Aux input alarm nr1	The device connected to the input alarm port 1 caused an alarm condition	RED	MAJOR	Check the status of the connected device	-
Aux input alarm nr2	The device connected to the input alarm port 2 caused an alarm condition	RED	MINOR	Check the status of the connected device	-
Aux input alarm nr3	The device connected to the input alarm port 3 caused an alarm condition	RED	WARNING	Check the status of the connected device	-

Table 4.1.5: Description of the alarms of the TPRN subrack

equipment. The default status of these input ports can be defined through the Supervision System. After that, any change from default status will be revealed as a failure signal.

- a summary of major and minor alarms related to failures detected not only on the TPRN sub-rack, but also on any active modules hosted by the TPRN itself.
- 2 relay output ports, which be can used to drive any external device connected to subD-15 pins adapter. By using the Supervision System, each of these output ports be can set up in "open" or "close" modes.

A more detailed description of the meaning and functionality of each pin is reported in Table 8. The pins are numbered from left to right, and from top to bottom (refer to Fig. 4.1.8).

Note: The TPRN sub-rack uses I2Cbus standard protocol to collect status and alarm information from hosted modules. Thanks to that, the alarm summaries (provided through pins 5-6 and 7-8) report major and minor failures related not only to the TPRN sub-rack but also to any hosted modules.

TPRN alarms

A full description of all TPRN alarms is provided by the Supervision System.
Table 4.1.5 provides a brief description of the TPRN alarms, as they are reported by the LMT software.

Warning (recommended for system designing and installing)

Providing correct heat dissipation

For correct use of the TPRN sub-rack, it is important to verify that:

- the system is designed for no more than 8 TFLNs inside a TPRN sub-rack. This guarantees proper heating dissipation for the system. In case you want to install more than 8, it is important to provide the sub-rack with a proper ventilation system;
- active and passive modules should be alternated as much as possible inside the TPRN sub-rack avoiding too many active cards being inserted close together;
- in case the system consists of more than one TPRN sub-rack, a minimum distance of 1 HE has to be kept between nearby TPRN sub-racks to ensure proper heat dissipation. The rack containing the TPRN sub-racks has to be large enough to guarantee this correct distance between master units.

Minimizing equipment costs

In order to reduce the cost of ION-B equipment, a multi-sub-rack system should be designed according to the following guidelines:

- a passive sub-rack (TPRN04) may be used to house only passive modules;
- an active sub-rack (TPRN14, TPRN24, TPRN34) may be used to sustain all the active modules, and some of the passive ones (as stated above, it is advisable to alternate active and passive cards in an active sub-rack).

Setting the dip-switches in a multi sub-rack system

If you are installing a multi-sub-rack system, remember to assign each sub-rack an exclusive binary address, by properly setting dip-switches 1,2,3,4 on the interior TPRN backplane (see Fig. 4.1.7 and Tab.4.1.3). Dip-switch 5 has to be set on each TPRN sub-rack in order to fix the baud rate for the RS485 and RS232 ports. Connecting the TPRNs through the RS485 port is necessary when supervising the whole multi sub-rack system through the remote supervision unit (to be set at the same baud rate).
The TPRN kit provides:

TPRN Installation

Figure 4.1.9: Some of the installation accessories provided with the TPRN subrack: (a) suitable power cord; (b) standard RJ-45 cable; (c) RS232 cable; (d) 1 Cd rom, including ION-B manuals

Figure 4.1.10: The TPRN is provided with a screwing hole on each front corner, thus allowing proper fixing to the installation rack.

The TPRN kit provides:

- 1 TPRN sub-rack
- suitable power cord (fig. 4.1.9a)
- 1 standard RJ45 cable (fig. 4.1.9b)
- 1 standard RS232 cable (male-female), 2m (fig. 4,1,9c)
- 1 CD Manual (fig. 4,1,8d)

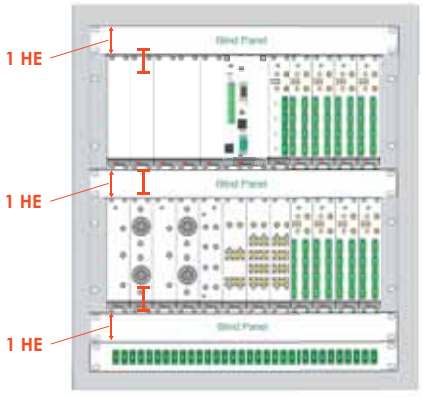


Fig. 4.1.11: intra-subrack distance must be at least 1HE to allow air circulation. 1-HE inter-subrack distances can be properly filled through blind panels

Firstly, insert the sub-rack into the cabinet and apply 4 screws (not provided) in order to fix it (Fig. 4.1.10).
To ensure correct TPRN installation, distance between the front door of the rack and the front side of the TPRN should be at least 15cm, otherwise the RF and optical cables could be damaged when cabinet door is closed.

Leave at least 1 HE distance between two subracks in order to facilitate air circulation (see Fig. 4.1.11).
Leave at least a 1 HE free space between the bottom or the top of the cabinet and the TPRNs (see Fig. 4.1.11).

Connect the ground to the safety ground terminal.
Then, connect the power supply connector to the mains (see Fig. 4.1.12).

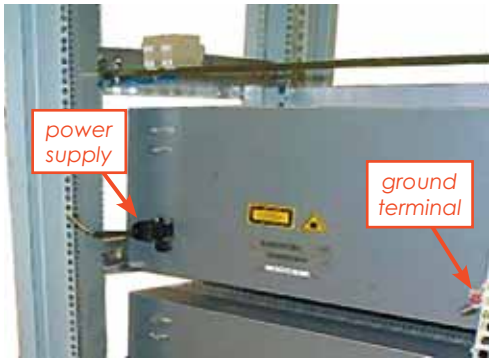


Figure 4.1.12:
Power supply and ground terminals on the rear side of the TPRN subrack

TPRN Start-up

Before switching on the TPRN sub-rack, make sure that:

- all necessary modules have been inserted
- the modules have been connected to each other by RF jumpers, according to what has been planned during the system design
- each TFLN contained in the Master Unit has been connected to its TFAx Remote Units
- each TFAx Remote Unit has been connected to its coverage antennas
- the remote supervision unit (if present) has been connected or housed to the Master Unit
- different sub-racks have been connected to each other via bus RS485 and each of them has different addresses
- the rack housing the TPRN is large enough to leave a minimum distance of 1HE between contiguous TPRN sub-racks

Remember that TFAx Remote Units have to be switched on before the relevant Master Unit.

Once the TPRN sub-rack has been switched on, the system behaviour can be summarized by the following steps:

- About 10sec after the TPRN sub-rack has been switched on, all TFLN modules housed in the TPRN itself begin a "discovery" phase in order to identify and collect status of the connected TFAx Remote Units. While the discovery phase is working (max. 4min. depending on the system complexity) each of the TFLN general alarms (i.e., LED "┘") blink, whereas the other TFLN LEDs go on showing the detected status.
  Do not connect/disconnect any cable or piece of equipment until all TFLN modules have finished the discovery phase. This may result in failing to identify the TFAx. Regardless, during the discovery phase, the entire system continues to work correctly as the discovery process aims to collect information about the TFAx but without affecting basic system functionalities.
- Once the discovery has finished, the general alarms (i.e. the LED "┘ ") on each TFLN panel stop blinking and switch OFF (provided that the TFLN master optical TRX is not affected by a general failure).

TPRN Troubleshooting

In case a TPRN sub-rack shows any problems, a more detailed status and alarm description is able to be provided through the remote supervision unit.
A complete overview of TPRN alarms is provided in Table 4.1.5.
A power supply degradation occurs in case the +12Vdc power falls below an in factory set threshold level. In this case, the TPRN automatically switches to standby mode so that no over-current is able to get through the circuitry of hosted modules, thus preserving the system's integrity. Once the power supply has been repaired, the TPRN needs to be rebooted. In case the TPRN sub-rack is equipped with a redundant power supply (TPRN24), a degradation of the +12 Vdc power results in an automatic switching from main to spare converter. In case a redundant power supply is degraded, the TPRN automatically turns to stand-by mode. Once the power supply has been repaired, the TPRN needs to be rebooted.
A I2Cbus alarm occurs when the TPRN sub-rack is not able to communicate with one or more of the hosted modules. Each TPRN slot is able to automatically detect the presence of a module inside the slot. If the module is detected but the TPRN is not able to communicate with it through the I2Cbus, an alarm is activated.

Note: at commissioning, remember to mask the unused slots through LMT software (please refer to the relevant manual for more information) to avoid triggering insignificant alarms.

Before carrrying out any troubleshooting procedures, please check the LMT or Supervision System handbooks.

4.2. Fast MiniRack, TPRF31

Major TPRN Features

The TPRF31 is a low-cost mini rack which can host 2 ION-B single-slot cards, such as:

- 2 Master Optical Trx, thus being able to drive up to 8 ION-B Remote Units
- 1 Master Optical Trx (driving up to 4 ION-B Remote Units) and a proper ION-B card, working as a Point-of-Interface (POI) towards the BTS. Please refer to fig,.7.5

External splitting-combining modules are optionally available, thus providing a complete solution for building simple and low-cost Distributed Antenna Systems.
Its installation-friendly brackets are suitable for both wall mounting and rack-mounting, thus making the installation of the ION-B Fast MiniRack easy and unobtrusive.

Thanks to its RS232 / RS485 bus, the TPRF31 Fast MiniRack can be fully integrated with any additional ION-B MiniRacks or standard racks, and managed through a full system supervision, using the ION-B standard supervision interface. Lastly, its external dry contacts and auxiliary inputs allow the Fast MiniRack to collect information about any external device, thus making it into a fully environment- embedded device.

(a)

(b)

Figure 4.2.1: Front view of the TPRF31 Fast MiniRack, both with free slots (a) and housing 2 TFLN master transceivers (b).

(c)

Figure 4.2.2: Rear view of the TPRF31 Fast MiniRack, powered -48 Vdc

Dimensions and Weight

Dimensions: 1 HE x 19", maximum length 300 mm
Weight: Please refer to bulletin PA-102187.1-EN
Operating temperature: 0°C to 55°C

On/Off Switch and Power Supply

The TPRF31 fast MiniRack can be powered from -36 to -72 Vdc. A fuse is provided underneath the -48 Vdc connector, and must be replaced in case of failure (when it happens, the Supervision System will detect the failure).

Figure 4.2.3: Rear view of the TPRF31 Fast MiniRack: Power supply connectors and On/Off switches

Reset and Store/Clear buttons

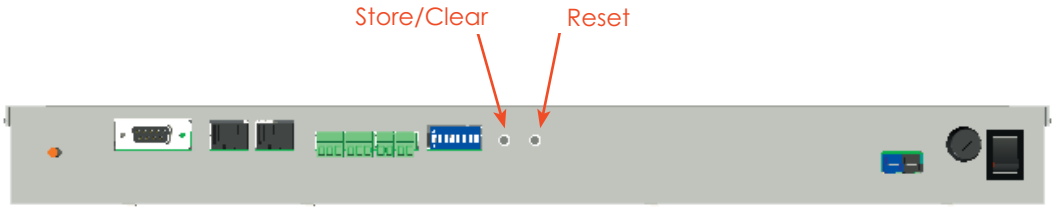


Figure 4.2.4: Rear view of the TPRF31 Fast MiniRack: Reset and Store/Clear buttons

Reset

The Reset button, located on the TPRF31 rear side, performs a complete reset of the Fast MiniRack, and is particularly useful when the MiniRack bus has become blocked in any way. Compared to the "manual reset" which can be perfomed by switching off and on the system through the On/Off switch, the Reset button is preferrable because it does not cause any interruption in feeding the TPRF31.

Store/Clear

The Store/Clear button, located on the TPRF31 rear side, carries out a complete masking of

the unused TPRF31 slots and of its TFLN ports. This operation should be perfomed during the initial system installation, after all of the TFLN units which are hosted by the TPRF31 MiniRack have stopped blinking (i.e., after they have finished the discovery phase: see the TFLN section of this User Manual for further clarification).
The Store/Clear operation must also be perfomed after any change affecting the TPRF slot configuration and the used ports on the TFLN transceivers.

When switching on and off the system in any other circumstances, no Store/Clear operation is normally required.

Visual Alarms

The TPRF31 front panel is provided with 2 LEDs (see fig. 4.2.5), showing status and alarm information.
LED significances are provided in the following table.

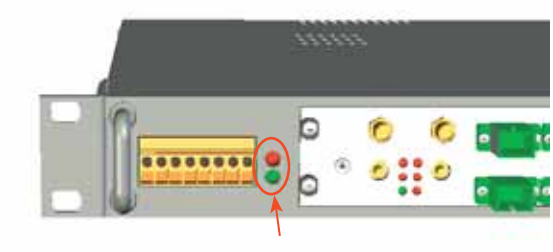


Figure 4.2.5: TPRF31 visual alarms

LED colour	Significance
Green	Power supply status OK
Red	Failure on the TPRF31, on one of the TFLN master transceivers, or on one of the connected Remote Units

Table 4.2.1 : Meaning of the LEDs on the TPRF31 front-side

Further information about alarm status is delivered by the ION-B Supervision Systems.

TPRF31 Ports

The TPRF31 is provided with a series pf ports which allow for the connection to any external device. These different ports are described hereinafter.

RS232 Serial Port

The RS232 serial port can be used to connect the TPRN sub-rack to the remote supervision unit or to a laptop running LMT software. Please note that a standard RS232 cable is needed.
The connection baud rate can be set to 9600bps, 19200bps, 57600bpa, or 115200 bps by properly setting the dip-switch 6 and 7 standing on the rear panel of the TPRF31 backplane (fig. 4.2.6). The baud rate setting through the dip-switches 6 and 7 is shown in Table 4.2.2

Baud Rate [bps]	Dip-switch 6	Dip-switch 7
9600	OFF	OFF
19200	ON	OFF
57600	OFF	ON
115200	ON	ON

Table 4.2.2 - Setting the RS232 baud-rate4 through dip-switches 6 and 7

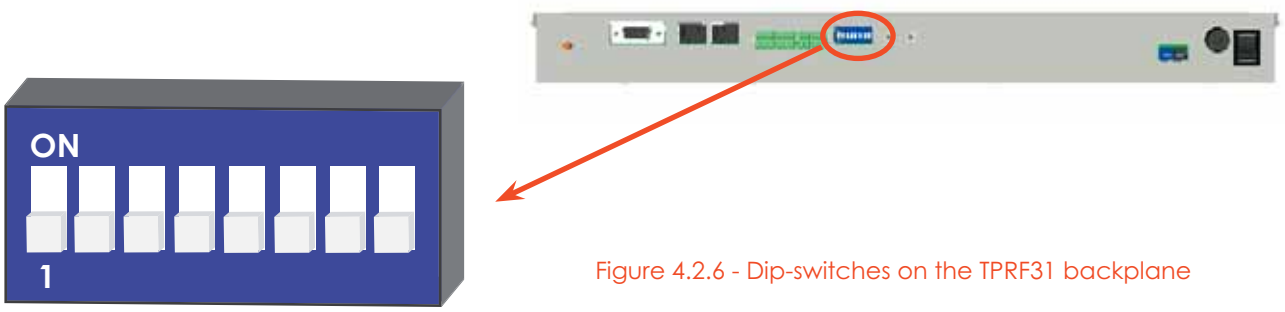


Figure 4.2.6 - Dip-switches on the TPRF31 backplane

Whichever baud rate you choose through dip-switches 6 and 7, remember that:

- the same RS232 connection speed must be set up on the remote supervision unit
- the baud rate which is selected through the dip-switches 6 and 7 set the connection speed for both the RS232 port and the RS485 port as the TPRN uses both ports with the same rate.

RS485 Port

The RS485 port consists of two RJ45 connectors, which can both work as input or output ports to and from a RS485 bus.
This RS485 bus has to be used in order to connect a multi sub-rack system to the remote supervision unit. In this case:

- the TPRN sub-racks have to be connected to one another via an RS485 bus in a chain;
- In order to monitor the entire system, the remote supervision unit has to be connected to one of the TPRN sub-racks through an RS232 port.

Before connecting the TPRN sub-racks belonging to a multi-sub-rack system, remember to assign an exclusive binary address to each one. This is essential in order to let the Supervision System recognize the different master units without any conflict.

The binary address assignment can be done through dip-switches 1, 2, 3, 4 and 5 which are located on the interior TPRN backplane (see Fig 4.2.5). A list of the correspondences between the addresses and the dip-switches is provided in Table 4.2.2: simply note that dip-switch 1 is the least significant binary digit, while dip-switch 5 is the most significant.

The baud rate of the RS485 ports is the same as the RS232 port as per the dip-switch 5 setting.

Address (Dec)	Address (Bin)	Dip-switch 1	Dip-switch 2	Dip-switch 3	Dip-switch 4	Dip-switch 5
1	00001	ON	OFF	OFF	OFF	OFF
2	00010	OFF	ON	OFF	OFF	OFF
3	00011	ON	ON	OFF	OFF	OFF
4	00100	OFF	OFF	ON	OFF	OFF
5	00101	ON	OFF	ON	OFF	OFF
6	00110	OFF	ON	ON	OFF	OFF
7	00111	ON	ON	ON	OFF	OFF
8	01000	OFF	OFF	OFF	ON	OFF
9	01001	ON	OFF	OFF	ON	OFF
10	01010	OFF	ON	OFF	ON	OFF
11	01011	ON	ON	OFF	ON	OFF
12	01100	OFF	OFF	ON	ON	OFF
13	01101	ON	OFF	ON	ON	OFF
14	01110	OFF	ON	ON	ON	OFF
Reserved	01111	ON	ON	ON	ON	OFF
Reserved	10000	ON	OFF	OFF	OFF	ON
17	10001	ON	OFF	OFF	OFF	ON
18	10010	OFF	ON	OFF	OFF	ON
19	10011	ON	ON	OFF	OFF	ON
20	10100	OFF	OFF	ON	OFF	ON
21	10101	ON	OFF	ON	OFF	ON
22	10110	OFF	ON	ON	OFF	ON
23	10111	ON	ON	ON	OFF	ON
24	11000	OFF	OFF	OFF	ON	ON
25	11001	ON	OFF	OFF	ON	ON
26	11010	OFF	ON	OFF	ON	ON
27	11011	ON	ON	OFF	ON	ON
28	11100	OFF	OFF	ON	ON	ON
29	11101	ON	OFF	ON	ON	ON
30	11110	OFF	ON	ON	ON	ON
Reserved	11111	ON	ON	ON	ON	ON

Table 4.2.3 : Dip-switches address settings

Whichever baud rate you choose, remember that:

- the same RS485 connection speed has to be set up on all connected devices (TPRN sub-racks or TSUN remote supervision unit);
- the baud-rate which is selected through the dip-switches 6 and 7 set the connection speed for both the RS485 port and the RS232 port.

Dip-switch 8 is used to match the impedance of a terminal TPRF31 node to the impedance of the transmission line being used. When the TPRF31 is the first or the last node of a subrack-chain, Dip-switch 8 can be set to ON if the length of the RS485 cables in the chain is such to cause a significant propagation delay, compared to the bit width (and therefore to the baud rate previously set).
In no such case, Dip-switch 8 can be set to OFF.

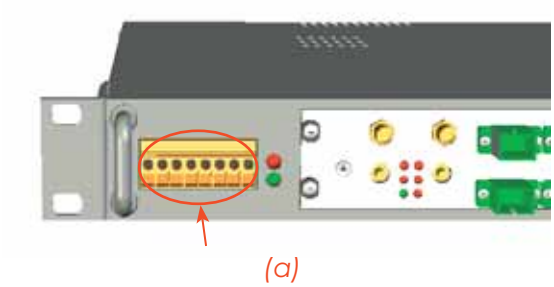
485 Bus Termination Load	Dip-switch 8
Not connected	OFF
Connected	ON

Table 4.2.4 : Settiing the $85 Bus termination Load through Dip-Switch 8

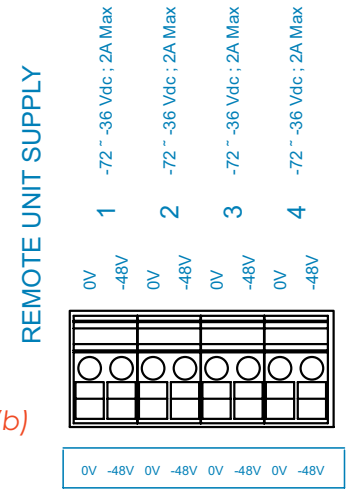
Power Supplying Ports

The front side of the TPRF31 Fast MiniRack is provided with 4 power supplying ports, conveying the -48Vdc power supply to up to 4 ION-B Remote Units.

Please refer to Bulletin PA-101187-EN in order to check that the overall maximum power the TPRF31 provides to your Remote Units is below the overal maximum power supported by the unit.



(a)



(b)

Figure 4.2.7:
TPRF31 Power supplying ports on TPRF31 front side (a),
Connection scheme of the power supply ports (b)

Auxiliary Inputs

The rear side of the TPRF31 Fast MiniRack is provided with two auxiliary input alarms, allowing the monitoring of the alarm status (on/off) of any external device. The alarm status is able to be associated either with the open-circuit or the closed-circuit status by properly setting the TPRF31 page of the TSUN Supervision Interface.
Auxiliary input connectors are Phoenix Contact MC1,5-2-G-3.5 connectors

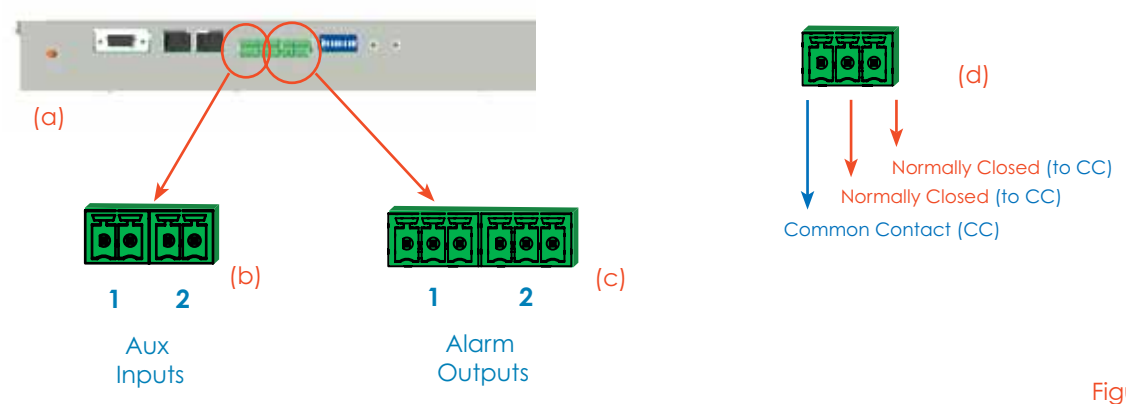


Figure 4.2.8:
Auxiliary Inputs (b) and External Alarm Outputs (c) on the TPRF31 rear side (a). Description of the External Alarm Outputs (d). Alarm Outputs 1 and 2 (c) refers to Major and Minor alarms, respectively

External Alarms

The rear side of the TPRF31 Fast MiniRack is provided with two Alarm-output dry-contacts, which are able to provide alarm information about Major Alarms (Alarm Outputs 1, see Figure 4.2.8 c) and Minor Alarms (Alarms Output 2, see Figure 4.2.8 c).
A full description of these Major and Minor Alarms is provided in Table 4.2.
External Alarm Outputs are Phoenix Contact MC1, 5-3-G-3.5 connectors.

Alarm Output N°	Description	Active Alarm	Severity
1	Major and Critical alarms	None	---
		I2CBus alarm	Critical
		Vcc	Major
		Slot 1 does not host a card and is not masked	Critical
		Slot 2 does not host a card and is not masked	Critical or Major
		At least one sub-system unit has a critical or major alarm	Major
2	Minor and Warning alarms	None	---
		Temperature	Warning
		At least one sub-system unit has a critical or major alarm	Minor or Warning

Table 4.2.5: Description of the Alarm information available through the External alarm contacts

Warning (recommended when designing or installing)

Providing correct heat dissipation

For correct use of the TPRF31 sub-rack, it is important to verify if:

- the TPRF31 has been mounted in a vertical position (please refer to the "TPRF31 Installation" section), the power supplying ports (located on the TPRF31, front side, Figure 4.2.7) have been turned upwards
- the TPRF31 has been mounted on a rack (please refer to the "TPRF31 Installation" section), a minimum distance of 1 HE has to be kept between nearby TPRN sub-racks to ensure proper heat dissipation. The rack containing the TPRN sub-racks has to be large enough to guarantee this correct distance between Master Units.

Setting the dip-switches in a multi sub-rack system

If you are installing a multi-sub-rack system, remember to assign each sub-rack an exclusive binary address, by properly setting dip-switches 1, 2, 3, 4, 5 on the TPRF31 backplane (see Fig. 4.2.6 and Table 4.2.3). Dip-switch 5 has to be set on each TPRN sub-rack in order to fix the baud rate for the RS485 and RS232 ports. Connecting the TPRNs through the RS485 port is necessary when supervising the whole multi sub-rack system through the remote supervision unit (to be set at the same baud rate).

TPRF31 Installation

The TPRN kit provides:

- 1 TPRF31 sub-rack
- 1 power supply cable
- 1 standard RS232 cable (male-female)
- 3 Alarm-output connectors
- 3 Auxiliary input connectors
- 1 Cd-rom, including ION-B manuals and tools

The TPRF31 Fast MiniRack is provided with some reversible brackets and suitable both for rack-mounting and for wall-mounting.

Straight from the factory, the TPRF31 has brackets for rack-mounting which cannot be removed for wall mounting (see figure 4.2.9).

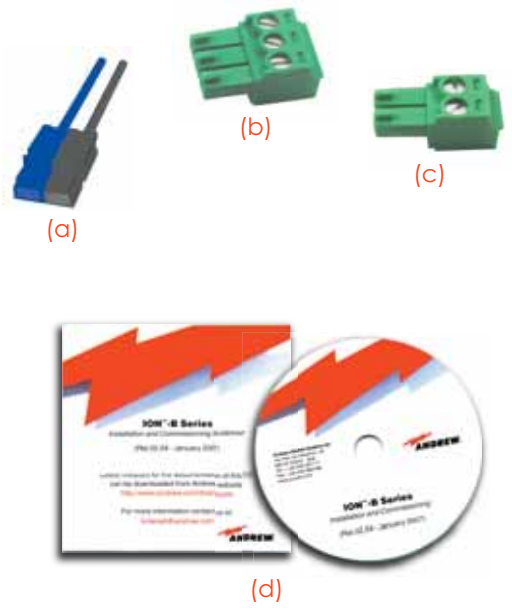


Figure 4.2.9:
Some of the installation accessories provided with the TPRF31
- (a) power supply cable;
- (b) 3-pole alarm-output connector
- (c) 2-pole auxiliary input connector,
- (d) 1 Cd rom, including ION-B manuals and tools

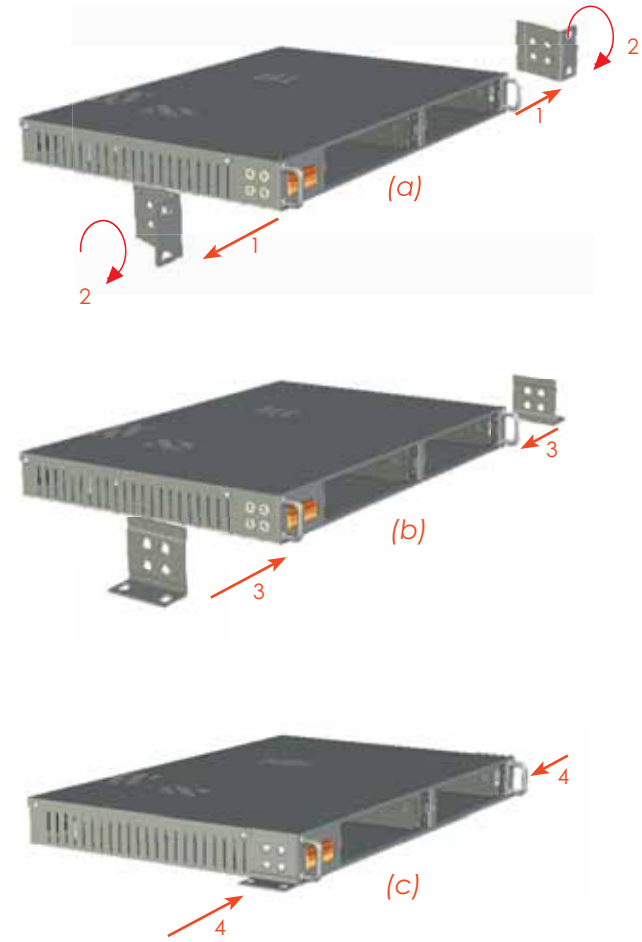


Figure 4.2.10:
Turning the brackets of the TPRF31 Fast MiniRack, starting from the factory configuration (a). Once the brackets have been turned and properly fixed, the TPRF31 Fast MiniRack is ready for wall-mounting (d).

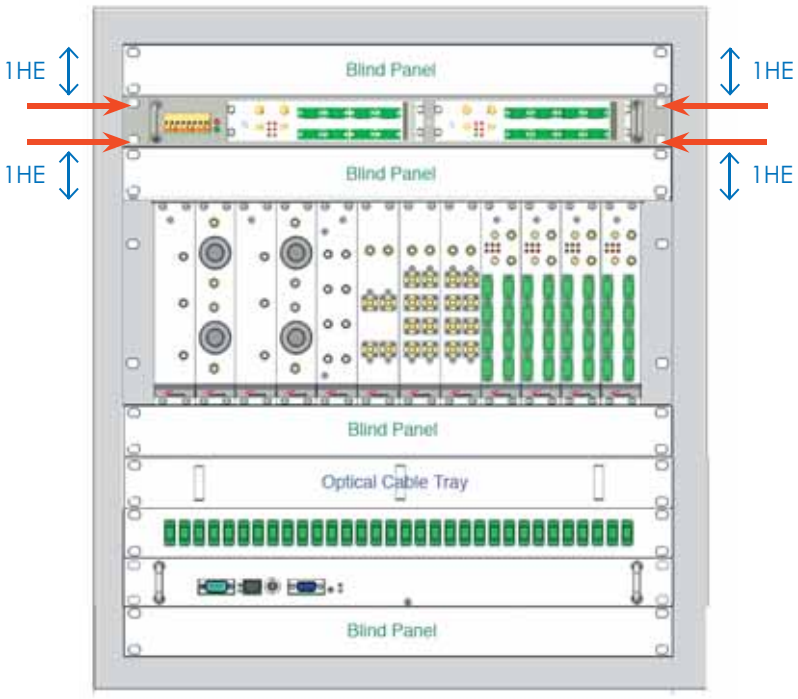


Figure 4.2.11:
Turning the brackets of the TPRF31 Fast MiniRack, starting from the factory configuration (a). Once the brackets have been turned and properly fixed, the TPRF31 Fast MiniRack is ready for wall-mounting (d).

Mounting the TPRF31 on a rack

Firstly, insert the sub-rack into the cabinet, and apply 4 screws (not provided) in order to fix it (Fig. 4.2.11).
To correctly install the TPRN, the distance between the front door of the rack and the front side of the TPRF31 should be at least 15cm, otherwise optical cables and any eventual RF cables might be damaged when the cabinet door is closed.

Leave at least 1HE distance between the TPRF31 Fast MiniRack and any other subrack element, in order to facilitate air circulation.
Leave at least a 1HE of free space between the bottom or the top of the cabinet and the TPRF31s.

Figure 4.2.12:
Wall-mounted TPRF31 Fast MiniRack, hosting 2 TFLNs master unit trahnsceivers

Mounting the TPRF31 on a wall

After proper turning and fixing of the brackets (according to that shown in Figure 4.2.10), drill into the wall according to the layout in Figure. 4.2.13).

It is strongly suggested to mount the TPRF31 with the the power supplying ports (on the TPRF31, front side, Fig. 4.2.7) turned upwards

Insert the 4 anchors into the holes you have just drilled, then fix the TPRF31 firmly to the wall by tightening the screws into the anchors.

TPRF31 Start-Up

Before switching on the TPRN sub-rack, make sure that:

- all the expected modules have been inserted
- the modules have been connected to each other by RF jumpers, according to what has been planned during the system design
- every TFLN contained in the Master Unit has been connected to its TFAx Remote Units
- each TFAx Remote Unit has been connected to its coverage antennas
- the remote supervision unit (if present) has been connected or housed to the Master Unit
- different sub-racks have been connected to each other via an RS485 bus and each of them have different addresses
- the rack housing the TPRF31 is large enough to leave a minimum distance of 1HE between contiguous TPRF31 sub-racks

Remember that TFAx Remote Units should be switched on before relevant Master Units.

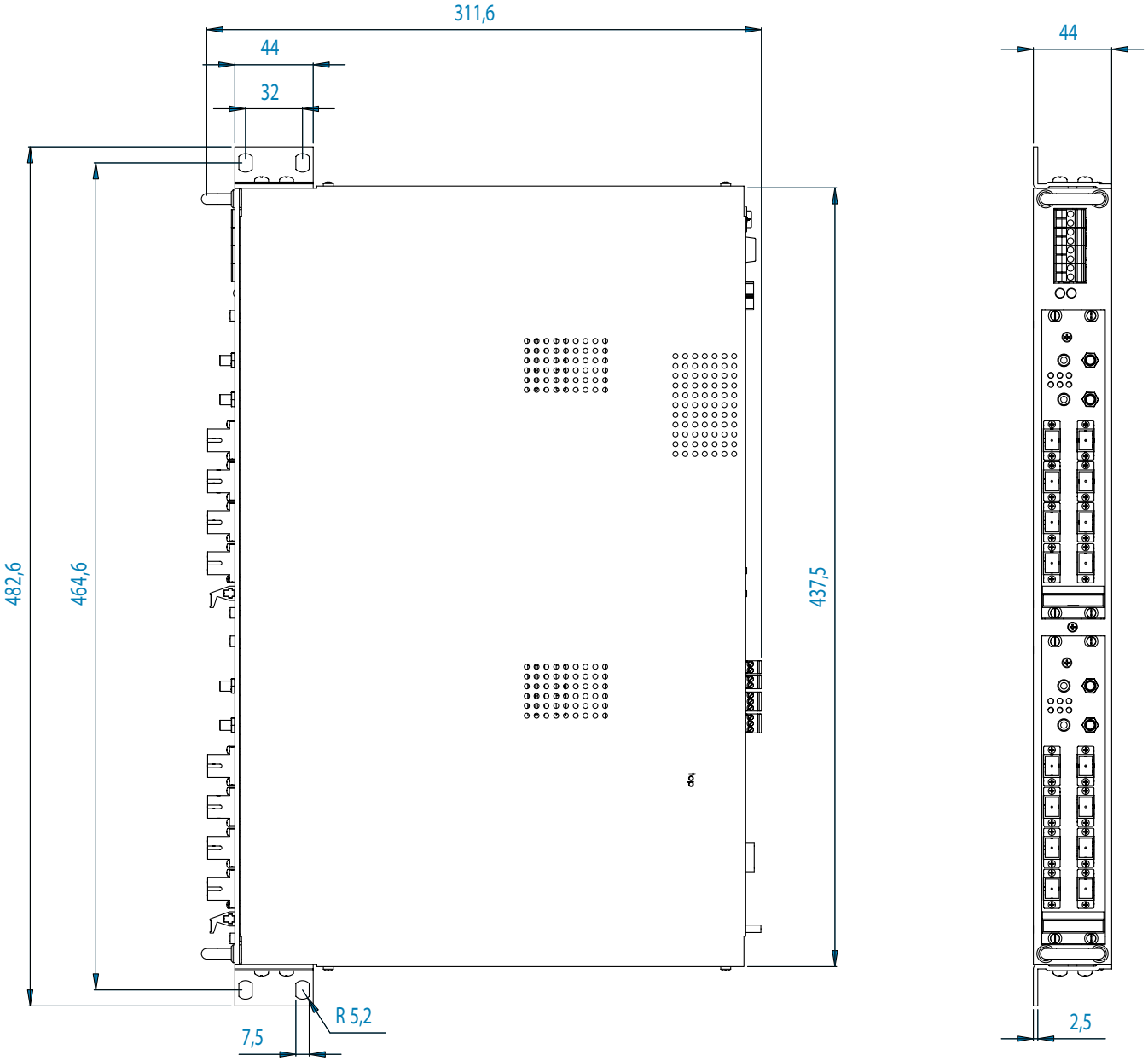


Figure 4.2.13: Mechanical Layout for wall-mounting the TPRF31 Fast MiniRack

Once the TPRF31 sub-rack has been switched on, the system behaviour can be summarized by the following steps:

- About 10sec after the TPRF31 sub-rack has been switched on, any TFLN modules housed in the TPRN itself begins a "discovery" phase in order to identify and collect status of the connected TFAx Remote Units. While the discovery phase is proceding (max. 4min. depending on the system complexity) each TFLN general alarm (i.e., LED " ┘ ") blinks, whereas the other TFLN LEDs go on showing the detected status.
  Do not connect/disconnect any cable or piece of equipment until all TFLN modules have finished the discovery phase. This may result in failing to identify the TFAx. Regardless, during the discovery phase, the entire system continues to work correctly as the discovery process aims to collect information about the TFAx without affecting basic system functionalities.
- Once the discovery has finished, the general alarms (i.e. the LED " ┘ ") on each TFLN panel stopsblinking and switch OFF (provided that the TFLN master optical TRX is not affected by a general failure).

TPRF31 Troubleshooting

Alarm code (TSUN description)	Alarm description	LED Colour	Severity	Alarm output**
Temperature	Over-temperature Alarm	-	Warning	2
I2CBus alarm	Internal I2Cbus communication malfunctioning	Red	Critical	1
Vcc	Power supply degradation, with internal voltage falling below critical threshold	Red	Major	1
Summary Slot 1	The TPRF31 slot 1 is not masked, in spite of not hosting any card	Red	Critical	1
Summary Slot 2	The TPRF31 slot 2 is not masked, in spite of not hosting any card	Red	Critical	1
Auxiliary Input 1	The auxiliary input 1 is in alert status *	Red	Major	1
Auxiliary Input 2	The auxiliary input 2 is in alert status*	-	Minor	2

*(Default alert status is "Closed", but can be set differently through TSUN Supervision unit)

** The "Alarm output" field indicates the number of the External Alarm Output (Figures 4.2.7, Table 4.2.4) through which the alarm information is revealed

Table 4.2.6 : Description of the alarm of the TPRF31 subrack

In case a TPRF31 sub-rack shows any problems, more detailed status and alarm descriptions are able to be provided through the remote supervision unit.
A complete overview of the TPRF31 alarms is reported in the previous Table 4.2.14.
Please note that:

- The power supply degradation (Vcc) occurs in case the +12Vdc power falls below the critical threshold level. In this case, the TPR31 automatically turns to standby mode so that no over-current is able to get through the circuitry of hosted modules, thus switching off the active modules and preserving the system's integrity. As soon as the power supply voltage is restored to its standard level, the TPRF31 automatically turns on the active cards again. Should this not happen, press the Reset button (fig. 4.2.4).
- A I2Cbus alarm occurs when the TPRF31 sub-rack cannot communicate with one or more hosted modules. Each TPRF31 slot is able to automatically detect the presence of a module inside the slot. If a module is detected, but the TPRF31 is not able to communicate with it, the I2Cbus alarm is activated.

Note: during the system commissioning, remember to mask the unused slots by pressing the Store/Clear button (fig. 4.2.6) or through the LMT software (please refer to the relevant manual for more information) to avoid triggering insignificant alarms.

Before carrying out any troubleshooting procedures, please check the LMT or Supervision System handbooks.

4.3. Master Optical TRX, TFLN

Main tasks carried out by the TFLN module

Downlink (DL):

- RF-to-optical conversion of the input RF signal
- Optical splitting: input RF signal is split onto 4 optical outputs

Uplink (UL):

- Optical-to-RF conversion of the 4 input optical signals
- Automatic Gain Control (AGC) of each converted signal to compensate optical losses;
- RF combining of the 4 adjusted signals into a single RF output

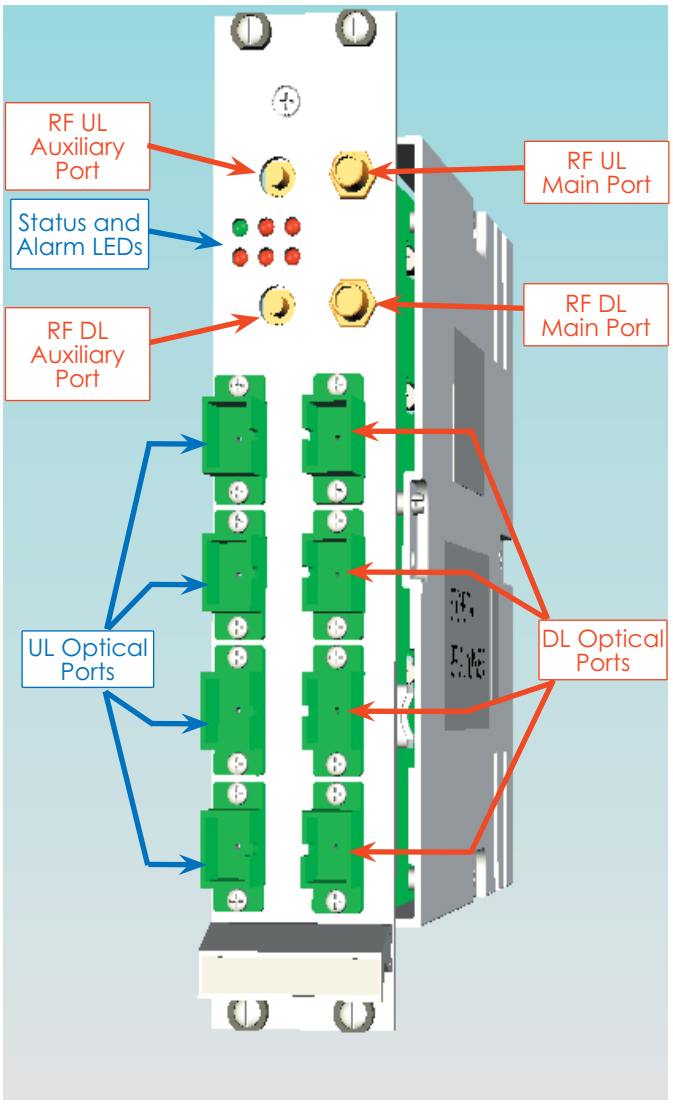


Figure 4.3.1: The TFLN Master Optical Transceiver

RF ports

- 1 DL RF input port
- 1 auxiliary DL RF input port
- 1 UL RF output port
- 1 auxiliary UL RF output port

Note: nominal input levels required at RF ports is +10dBm (please refer to datasheet for further information), as well as RF outputs may require a power adjustment to fill within the BTS receiving range.
In order to fulfil these requirements, external UL and DL attenuations may be required (see TBSI module).

Optical ports

- 4 DL optical output ports (SC/APC)
- 4 UL optical input ports (SC/APC)

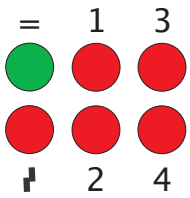


Fig 4.3.2:
Visual alarms on the TFLN Master Optical Transceiver.

Label	LED colour	Significance
=	Green	Power supply status OK
⌐	Red	General TFLN failure, it might be:- TFLN laser failure - UL or DL amplifier failure - TFLN short circuit
1	Red	Low UL optical power received from Remote Unit 1 (fault in optical link 1 or Remote Unit 1 failure)
2	Red	Low UL optical power received from Remote Unit 2 (fault in optical link 2 or Remote Unit 2 failure)
3	Red	Low UL optical power received from Remote Unit 3 (fault in optical link 3 or Remote Unit 3 failure)
4	Red	Low UL optical power received from Remote Unit 4 (fault in optical link 4 or Remote Unit 4 failure)

Table 4.3.1:
Visual alarms on the TFLN Master Optical Transceiver.

TFLN Visual Alarms

The TFLN front panel is provided with 6 LEDs (see right), showing status and alarm information.
LED significance is reported on the above table.
Further information about alarm status is delivered by the ION-B Supervision System.

Note: In case the four TFLN optical output ports are not all connected to Remote Units, the unused ports must be properly masked at commissioning in order to avoid spurious alarms (please refer to LMT manual).

TFLN power supply

Each TFLN master optical TRX is supplied by the sub-rack backplane (12V).
The power consumption of each TFLN master optical TRX is 12W.

Warnings (to be read before TFLN installation)

Dealing with optical output ports

- The TFLN master optical TRX contains semiconductor lasers. Invisible laser beams may be emitted from the optical output ports. Do not look towards the optical ports while equipment is switched on.

Handling optical connections

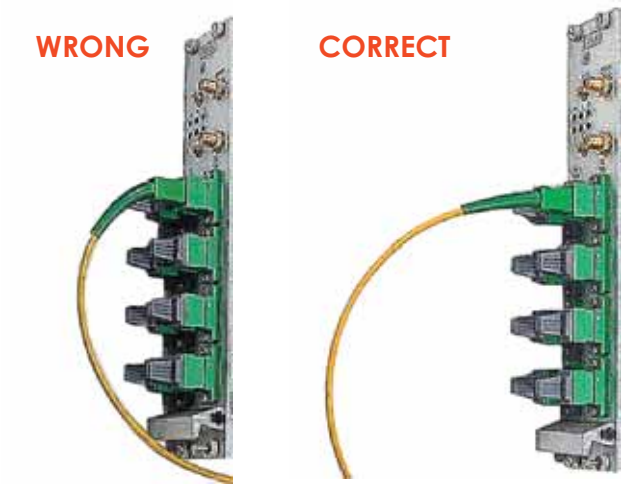


Fig. 4.3.3: Fiberoptical bending

- When inserting an optical connector, take care to handle it in order not to damage the optical fibre. Optical fibres have to be single-mode (SM) 9.5/125µm.
- Typically, ION-B equipment is provided with SC-APC optical connectors. Inserting any other connector will result in severe damages.
- Do not force or stretch the fibre pigtail with a radius of curvature less than 5 cm. See Fig. 19 for optimal fibre cabling.
- Remove adapter caps only just before making connections. Do not leave SC-APC adapters open, as they attract dust. Unused SC-APC adapters must always be covered with their caps.
- Do not touch the adapter tip. Clean it thoroughly before inserting each connector into the sleeve. In case adapter tips need to be cleaned better, use pure ethyl alcohol

Inserting or removing TFLN modules

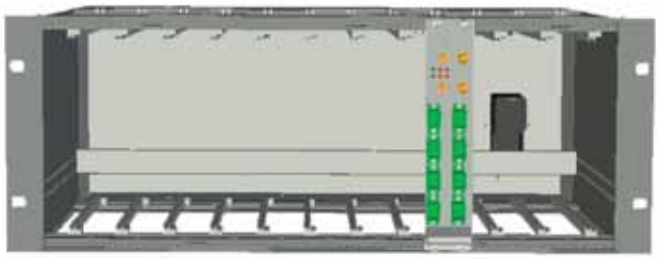


Fig. 4.3.4: Installing a TFLN module

Fig. 4.3.5: Proper cabling of SMA connectors on a TFLN front panel

- Do not remove or insert any TFLN module into TPRN sub-rack before having switched off main power supply.
- The TFLN modules must be handled with care, in order to avoid damage to electrostatic sensitive devices.
- When installing TFLN modules in the sub-rack, take care to alternate active and passive cards in order to ensure proper heat dissipation.
- In a multi-sub-rack system, remember to assign to each sub-rack a proper RS485 bus address before installing the modules (please refer to TPRN section for further details).

Fig 4.3.6:
Visual alarms on the TFLN Master Optical Transceiver.

TFLN Positioning

- In case no ventilation system has been installed, don't insert more than 8 TFLN modules into the sub-rack.
- In case more than 8 TFLN modules have to be housed in a TPRN sub-rack, it's advisable to install the TPRN sub-rack inside a rack with forced ventilation.

- Be careful to meet expected requirements for RF ports. An adjustable attenuator might be necessary if the power coming from the BTS exceeds the required levels, to avoid damaging the ION-B circuitry or an increase of spurious emissions.

TFLN Installation

The TFLN master optical TRX is housed in a TPRN sub-rack and its dimensions are 19" wide and 4HE high. A TFLN module is able to be accommodated in any of these 12 slots.

Note: In case a new TFLN module has to be installed in a still working Master Unit, switch off the sub-rack before inserting the plug-in TFLN module.

Firstly, gently insert the TFLN into one of the 12 available slots, and lock the 4 screws on the front corners.

Then, connect the UL and DL RF cable to the TFLN UL and DL ports, respectively.
Use an appropriate torque wrench to fix these RF cables to DL and UL ports.

Remove the caps from TFLN optical ports and connect the SC-APC fibre optic cables to the ports.
UL and DL cables coming from the same Remote Unit have to be connected to the UL and DL ports marked by the same number on the TFLN front panel.

As you switch on the system, carefully refer to the TFLN Start-Up section.
Remember that Remote Units should be switched on before the Master Unit in order to follow the correct Start-Up procedure.

Label	LED colour	Status
=	Green	ON (power supply is on)
⌐	Red	OFF (no major failure affects TFLN operations)
1	Red	OFF (no major failure affects corresponding Remote Unit or UL connection)
2	Red	OFF (no major failure affects corresponding Remote Unit or UL connection)
3	Red	OFF (no major failure affects corresponding Remote Unit or UL connection)
4	Red	OFF (no major failure affects corresponding Remote Unit or UL connection)

Table 4.3.2: LED alerts on the TFLN front panel

TFLN Start-Up

Before the Master Unit is switched on, make sure that:

- all necessary modules have been inserted into the Master Unit
- the modules have been connected each other by RF jumpers, according to what has been planned in the system design
- every TFLN master optical TRX has been connected to the relevant Remote Units
- each Remote Unit has been connected to its coverage antenna
- the remote supervision unit, if present, has been connected to the Master Unit
- different Master Units are connected to each other via bus RS485

Following this, the Master Unit itself can be turned on, making sure to turn on all the Remote Units first,

Once the Master Unit has been switched on, the behaviour of the TFLN at system start-up is able to be summarized with the following steps:

1. When the Master Unit is turned on, all six LEDs on the TFLN front panel remain lit for a couple of seconds. After that, the green LED remains lit (indicating proper power supply) while the other LEDs indicate the master optical TRX status, according to the following table.

Note: If the unused optical ports of the TFLN haven't been masked through the LMT yet, corresponding LEDs will be lit. If this is the case, wait for the end of step 3 (discovery phase) then use the LMT to mask them (please refer to relevant handbook)

2. About 10 seconds after the system has been switched on, the TFLN module begins a

Alarm Code (TSUN description)	Alarm description	Active LED	Supervision Priority Level	Action Recommended	Relé Priority Level
RX1 optical power fail	The optical power received on the UL1 is too low and can't no more be compensated	RED (LED1)	CRITICAL	Check the UL1 fibre and the Remote Unit laser status	MAJOR
RX1 AGC out of range	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	MINOR	Clean optical connectors	MINOR
RX2 optical power fail	The optical power received on the UL2 is too low and can't no more be compensated	RED (LED2)	CRITICAL	Check the UL2 fibre and the Remote Unit laser status	MAJOR
RX2 AGC out of range	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	MINOR	Clean optical connectors	MINOR
RX3 optical power fail	The optical power received on the UL3 is too low and can't no more be compensated	RED (LED3)	CRITICAL	Check the UL3 fibre and the Remote Unit laser status	MAJOR
RX3 AGC out of range	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	MINOR	Clean optical connectors	MINOR
RX4 optical power fail	The optical power received on the UL4 is too low and can't no more be compensated	RED (LED4)	CRITICAL	Check the UL4 fibre and the Remote Unit laser status	MAJOR
RX4 AGC out of range	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	MINOR	Clean optical connectors	MINOR
Major Remote Unit 1	Alarm from RU1	RED (LED1)	-	Check Remote Unit status	MAJOR
Major Remote Unit 2	Alarm from RU2	RED (LED2)	-	Check Remote Unit status	MAJOR
Major Remote Unit 3	Alarm from RU3	RED (LED3)	-	Check Remote Unit status	MAJOR
Major Remote Unit 4	Alarm from RU4	RED (LED4)	-	Check Remote Unit status	MAJOR
DL laser alarm	A fault occurs on the DL laser	RED (┘)	MAJOR	Return the unit	MAJOR
UL RF alarm	HW failure on the UL RF section	RED (┘)	MAJOR	Return the unit	MAJOR
DL RF alarm	HW failure on the DL RF section	RED (┘)	CRITICAL	Return the unit	MAJOR
Board failure alarm	General failure on board	RED (┘)	MAJOR	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	MINOR	Check ventilation and environment	MINOR

Table 4.3.3: LED alerts on the TFLN front panel

"discovery" phase to identify all connected Remote Units. This operation serves to collect all necessary information to be provided to the Supervision System.

During the discovery phase, the TFLN general alarm (LED "┘") blinks while the other LEDs go on showing their previously detected status'. Time dedicated to the discovery phase could be up to a maximum of 4 min. and depends on system complexity.

Do not connect/disconnect any cable or any piece of equipment during the discovery phase. This may result in failing to identify Remote Units.

Please note that, while the discovery phase is running, the whole system is working correctly as discovery operations aim only to collect information about Remote Units without affecting the system functionalities.

Note: in case discovery doesn't start automatically, check the LMT or the remote supervision whether it has been disabled (refer to the LMT or remote Supervision System manuals for further information).

Once the discovery is finished, the TFLN general alarm (LED "┘") stops blinking and switches OFF. The power supply LED (green) remains on while LEDs 1, 2, 3 and 4 show either the status of the Remote Units or the quality of the UL connections. In case some of these LEDs remain on, check if they refer to unused optical ports or not. In this case, use LMT software to mask it. Otherwise, if they refer to connected Remote Units and remain on, please refer to the troubleshooting procedures.

Removing a TFLN Module

Switch off the Master Unit power supply, remove the SC-APC optical connectors, and insert the protection caps into the TFLN optical ports. Then:

- unscrew the 4 screws and slowly remove the card
- put the removed TFLN card in its safety box
- switch the Master Unit power supply on again, and refer to the Start Up section.

TFLN Troubleshooting

In case a TFLN master optical TRX has any problems, this will be easily revealed through the LEDs on its front panels, otherwise troubleshooting can be carried out through the LMT or the Supervision System.
LEDs on the TFLN front panel detect not only failures on the TFLN board itself, but also reveal malfunctions located on related Remote Units.

The previous table reports a brief description of the TFLN alarms, together with a reference to the corresponding alerted LEDs.

As the table shows, LEDs on the TFLN front panel signal all high priority alarms while minor alarms, which detect critical situations which should be checked and tested in order to avoid future possible system faults, are only revealed by the LMT or the Supervision System.

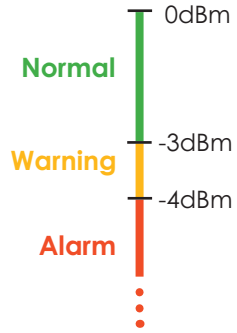


Fig. 3.6.6:
AGC thresholds vs LED alerts

Each TFLN is provided with an AGC system which compensates optical losses of <3 dB. TFLN LED alarms switch on when the estimated optical losses are >4dB, when the AGC is not able to compensate these losses any more.

One of LEDs,1, 2, 3 or 4, might turn on not only to indicate a high optical loss detected by the TFLN, but also to reveal a Remote Unit failure. Understanding the reason why one of LEDs 1, 2, 3 or 4 is on (a Remote Unit failure, an optical cable fault or an external equipment malfunction) can be done following the troubleshooting procedure reported hereinafter.

Quick Troubleshooting Procedure

(The following procedure is summarized by the flow-chart in fig. 4.3.7a)

1. If the TFLN general alarm (LED " ⌐┘") is on, replace the faulty TFLN master optical TRX with a new one and contact the manufacturer for assistance.
2. In case one of the LEDs, 1, 2, 3 or 4, is lit, the corresponding TFLN adapter might be dirty. Try cleaning it using pure ethyl alcohol. If the LED is still lit, go to the corresponding Remote Unit side and check the red LED on the TFAx warm side:
    a. If it is off, the optical cables or the optical connections are supposed to have some problem on UL path. Refer to fibre optic UL troubleshooting for more information (fig. 21).
    b. If it is on, refer to Remote Unit troubleshooting presented in the previous Remote Unit section

Fibre Optic UL Troubleshooting

(The following procedure is summarized by the flow-chart in fig. 4.3.7b)

1. Check if there is any point where the fibre experiences a small radius of curvature. In this case, rearrange the optical path in order to avoid sharp bends (if necessary, replace the optical cable with a longer one). If this causes the TFLN red LED to switch off, troubleshooting has been successful. Otherwise, follow this next step.
2. Check if the SC-APC connectors are properly installed at both fibre ends (i.e. TFLN and

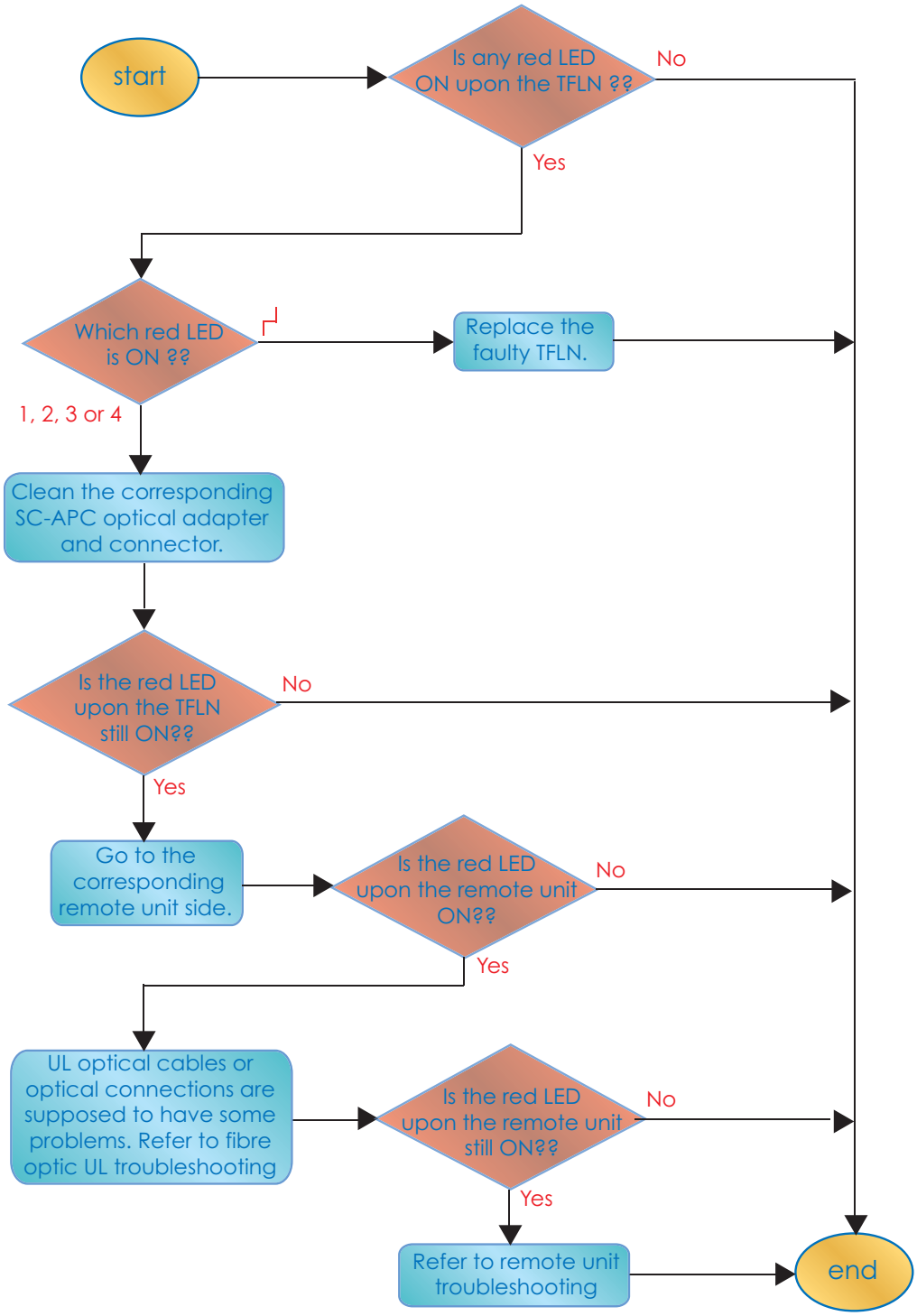


Fig. 4.3.7 (a): Flow-chart describing the quick troubleshooting procedure

TFAx ports). If not, fix the SC-SPC connectors better to their relevant adapters. If this causes the TFLN red LED to switch off, troubleshooting has been successful. Otherwise, follow this next step.

3. Disconnect the optical fibre and clean it at both fibre ends (i.e. TFLN side and TFAx side) then reconnect the fibre to relevant ports. In case this causes the TFLN red LED to switch off, troubleshooting has been successful. Otherwise, follow the next step.
4. Disconnect the optical SC-APC connector from TFLN UL port, and measure the output

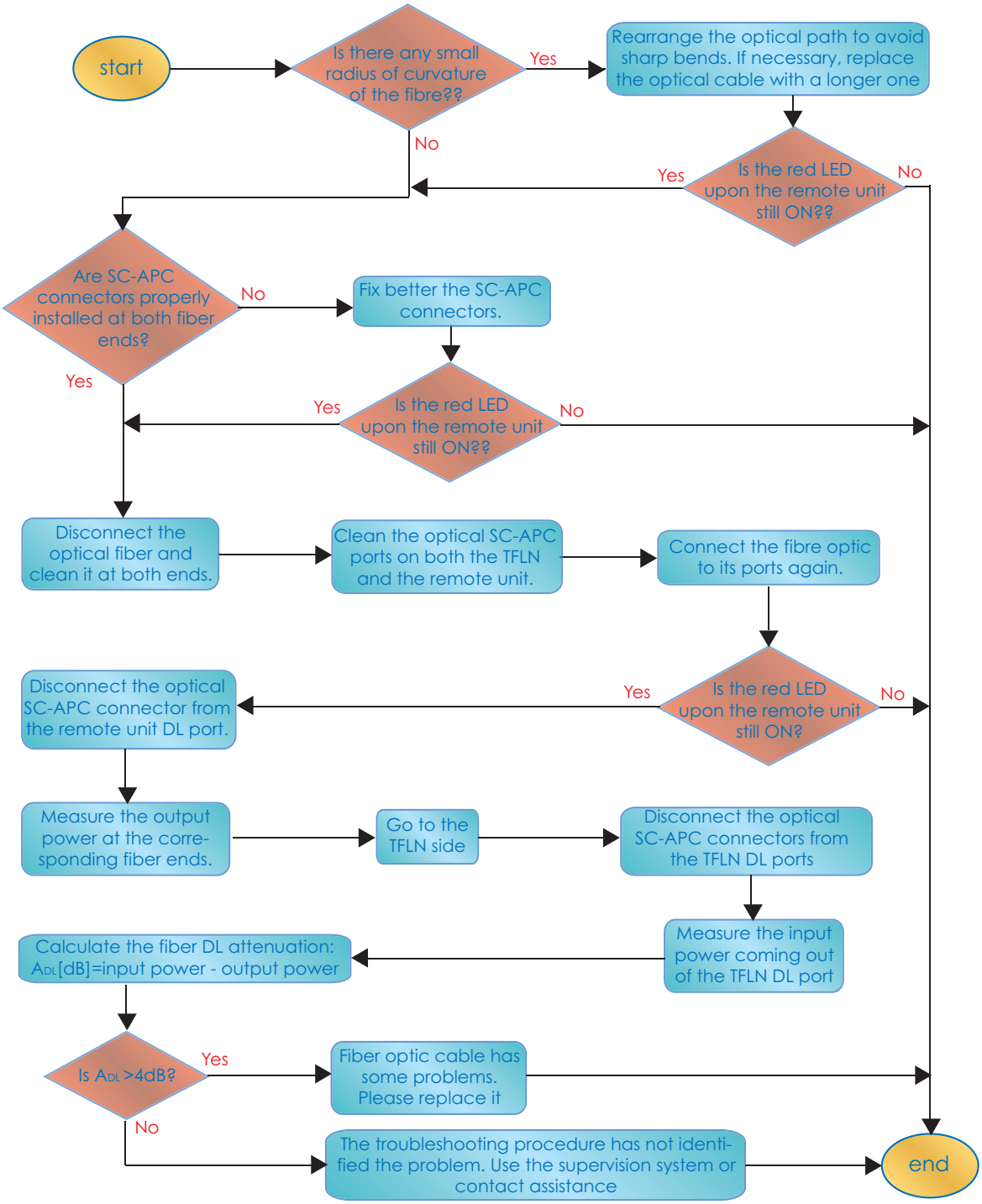


Fig. 4.3.7 (b): Flow-chart describing the quick troubleshooting procedure

power P_{OUT}(UL) at the corresponding fibre end. Then, go to the TFAx side, disconnect the optical SC-APC connector from TFAx UL port and measure the input power P_{IN}(UL) coming out of the TFAx UL port.

5. Calculate the UL fibre attenuation A_{UL} as: A_{UL} [dB] = P_{IN}(UL) – P_{OUT}(UL)
    a. If A_{UL} > 4dB, the fibre optic cable has some problems or the cable path is too long. Replace it.
    b. If A_{UL} < 4dB, then the TFAx Remote Unit could be faulty. Before replacing it, check the TFAx status on the Supervision System and contact for assistance

4.4. Two-way Splitter/Combiner, TLCN2

Description:

The TLCN2, a bidirectional 2-way splitter/combiner, provides two identical combining sections for UL and DL which can be used in the following ways:

- to combine 2 RF signals into a common RF output
- to split an RF input into 2 RF output signals

It is a passive wideband module.

RF Ports

- 1 DL common RF port ("C")
- 2 DL split RF ports ("1","2")
- 1 UL common RF port ("C")
- 2 UL split RF ports ("1","2")

Note: each port is bidirectional.

TLCN2 Main Applications

The main applications of the TLCN2 module are:

- Connecting a donor source to more than one TFLN master optical TRX, so that:
  - TLCN2 splits the DL input coming from a donor source into 2 output signals entering 2 different TFLN master optical TRXs
  - TLCN2 combines the UL inputs coming from 2 TFLN master optical TRXs into 1 common signal entering the donor source
- Connecting a TFLN master optical TRX to more than one donor source within the same service, so that:
  - TLCN2 combines the two DL inputs coming from 2 donor sources into 1 output signal entering the TFLN master optical TRX or a cross band coupler
  - TLCN2 splits the UL input coming from TFLN master optical TRX or a cross band coupler into 2 different output signals entering 2 different donor sources.

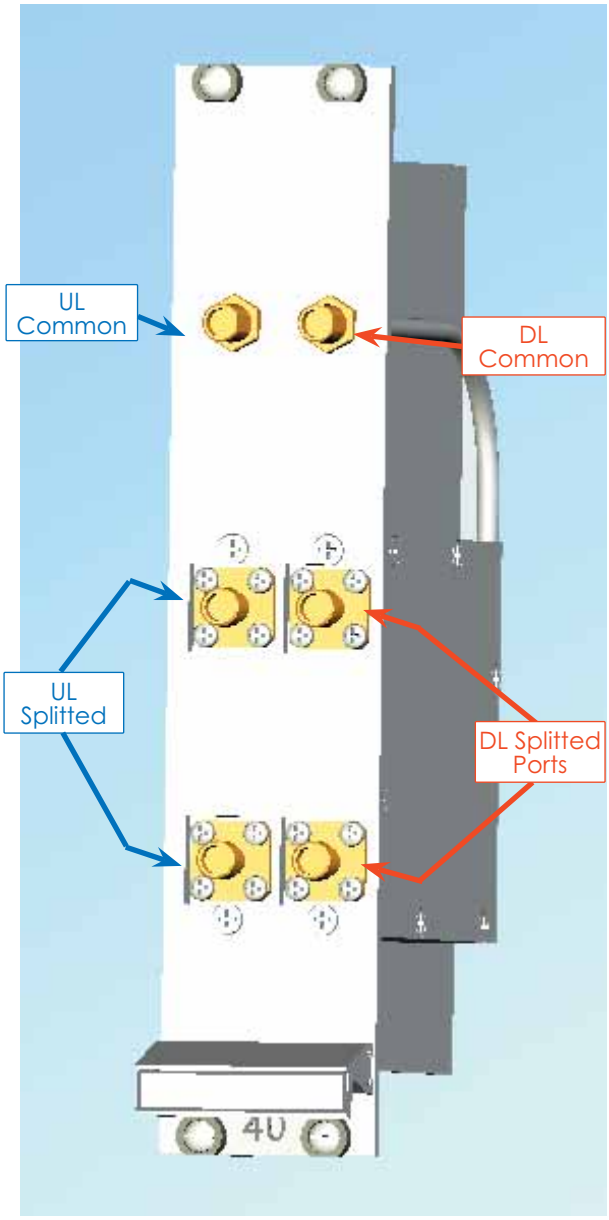


Fig 4.4.1: TLCN2 splitter/combiner

More TLCN2 modules can be used in cascade connections.

TLCN2 Insertion Loss

The TLCN2 insertion loss varies slightly depending on the frequency bands, as shown in table 4.7.
When designing the system, remember to take into account the insertion loss of the TLCN2, if

	700-1400MHz	1400-2200MHz	2200-2500MHz
TLCN2 insertion loss	3.7 ± 0.4dB	4.1 ± 0.5dB	4.6 ± 0.4dB

Table 4.4.1: Insertion loss values within different frequency bands

present.

Warnings

The overall input power must not exceed +24dBm.

TLCN2 Installation

Since the TLCN2 module doesn't require any power supply, it can be housed either in an active or a passive TPRN sub-rack.

1. Unpack the kit which includes
   - 1 TLCN2
   - 4 RF jumpers (SMA-m), 2 x 25 cm, 2 x 35 cm
2. Carefully insert the TLCN2 module into any of the TPRN sub-rack slots and lock the 4 screws on the front corners.
3. Connect RF cables to the UL and DL ports, according to what has been planned by the designer. Use an appropriate torque wrench to fix each cable to its relevant ports.
4. In case some ports remain unused, remember to connect them to a 50 Ω load (not included)

4.5. Four-way Splitter/Combiner,TLCN4

Description:

The TLCN4, bidirectional 4-way splitter/combiner, provides two identical combining sections for the UL and DL which can be used to:

- combine 4 RF signals into a common RF output
- split an RF input into 4 RF output signals

It is a passive wideband module.

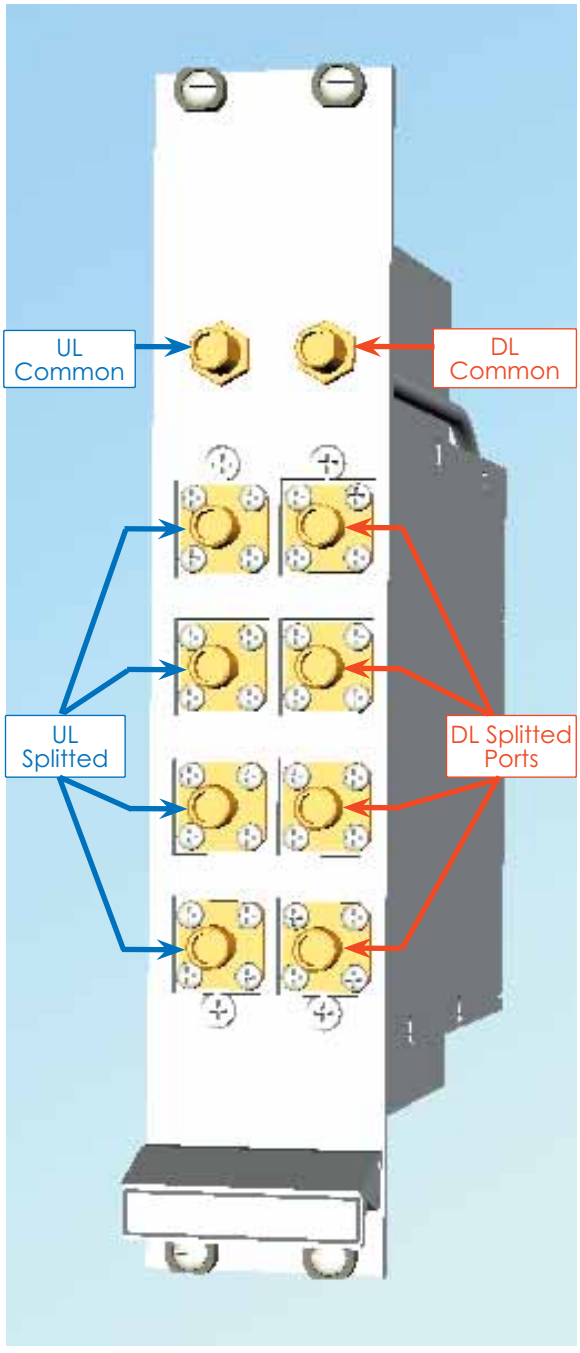


Fig. 4.5.1: TLCN4 splitter-combiner

RF Ports:

- 1 DL common RF port ("C")
- 4 DL split RF ports (labelled "1","2","3","4")
- 1 UL common RF port ("C")
- 4 UL split RF ports (labelled "1","2","3","4")

Note: each port is bidirectional.

TLCN4 Main Applications

The main applications of the TLCN4 module are:

- Connecting a donor source to more than one TFLN master optical TRX, so that:
  - ♦≈ℳ TLCN4 splits the DL input coming from a donor source into 4 output signals entering 4 different TFLN master optical TRXs
  - ♦≈ℳ TLCN4 combines the UL inputs coming from 4 TFLN master optical TRXs into 1 common signal entering the donor source
- Connecting a TFLN master optical TRX to more than one donor source within the same service, so that:
  - ♦≈ℳ TLCN4 combines the two DL inputs coming from up to 4 donor sources into 1 output signal entering the TFLN master optical TRX.
  - ♦≈ℳ TLCN4 splits the UL inputs coming from the TFLN master optical TRX into 4 different output signals entering up to 4 different donor sources.

More TLCN4 modules can be used in cascade connections.

TLCN4 Insertion Loss

The TLCN4 insertion losses vary slightly depending on the frequency bands, as shown in table 4.8.

	700-1400MHz	1400-2200MHz	2200-2500MHz
TLCN4 insertion loss	7.4 ± 0.4dB	8.0 ± 0.5dB	8.4 ± 0.4dB

Table 4.5.1: Insertion loss values within different frequency bands

When designing the system, remember to take into account the insertion loss of the TLCN4.

Warnings

The overall input power must not exceed +24dBm

TLCN4 Installation

Since the TLCN4 module doesn't require any power supply it can be housed either in an active or a passive TPRN sub-rack.

1. Unpack the kit which includes
   - 1 TLCN4
   - 8 RF jumpers (SMA-m), 1 x 18 cm, 2 x 23 cm, 2 x 28 cm, 2 x 33 cm, 1 x 36 cm
2. Carefully insert the TLCN4 module into any of the TPRN sub-rack slots and tighten the 4 screws on the front corners.
3. Connect RF cables to the UL and DL ports, according to what has been planned by the designer. Use an appropriate torque wrench to fix each cable to their relevant ports.
4. In case some ports remain unused, remember to connect them to a 50 Ω load (not included)

4.6. RF Dual Band Coupler TLDN

Description:

The TLDN is a passive RF dual band coupler designed to distribute signals within the master unit when coming from different bands.

Main operations carried out are:

- in downlink, it combines a low band RF signal (800MHz to 1000MHz) and a high band RF signal (1700MHz to 2200MHz) into a common RF path
- in uplink, it filters the composite signal into a low-band (800MHz to 1000MHz) and a high-band (1700MHz to 2200MHz)

It is a passive module.

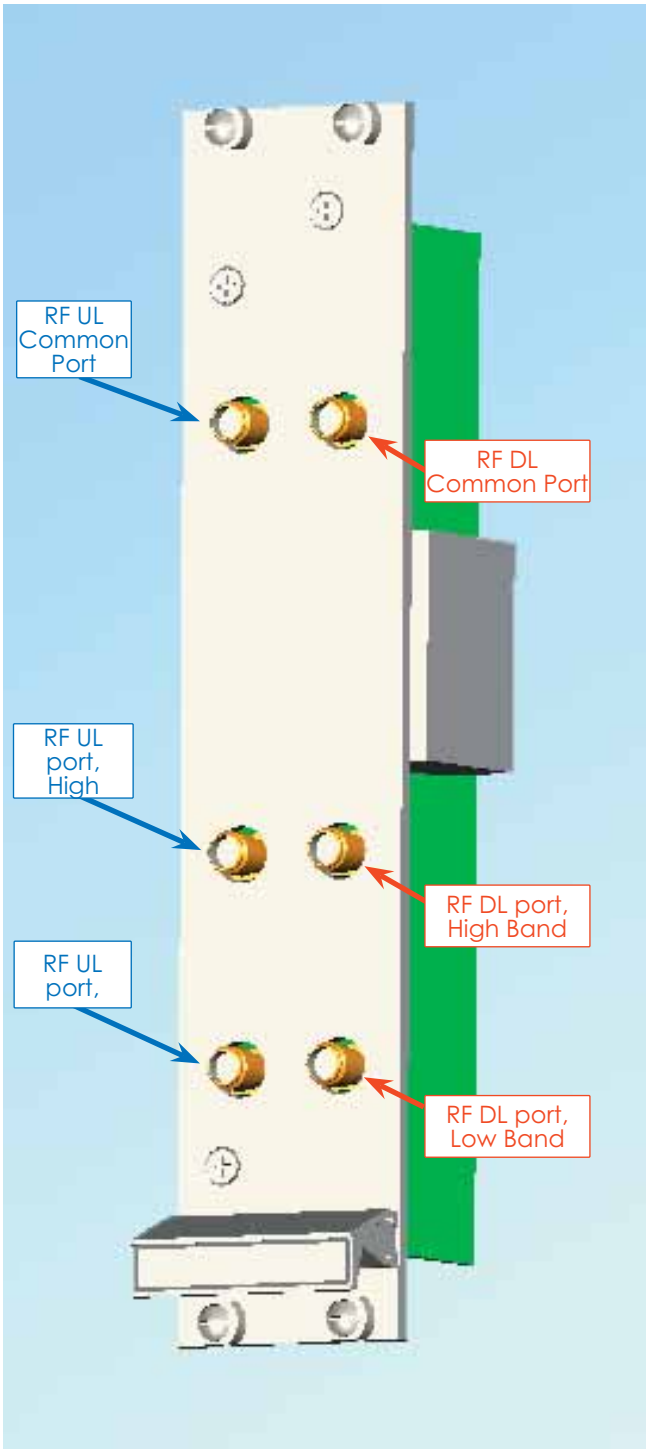


Fig. 4.6.1: TLDN dual band duplexer

RF Ports

- 1 UL common RF input port ("C") for the combined UL signal
- 1 UL high-band RF output port
- 1 UL low-band RF output port
- 1 DL common RF output port ("C") for the combined DL signal
- 1 DL high-band RF input port
- 1 DL low-band RF input port

TLDN Main Applications

Main applications of the TLDN module are:

- Connecting 2 donor sources with different services to one TFLN master optical TRX in a dual band system, so that:
  - the TLDN combines the DL inputs coming from the 2 different donor sources

(carrying different services) into an output signal entering the TFLN master optical TRX

- TLDN filters the UL input coming from a TFLN master optical TRX into 2 UL outputs entering 2 different donor sources (carrying different services)

TLDN Insertion Loss

TLDN insertion loss = 1.0 ± 0.5dB.
When designing the system, remember to take into account the insertion loss of the TLDN.

Warnings

The overall input power must not exceed +27dBm.

TLDN Installation

Since the TLDN module doesn't require any power supply, it can be housed either in an active or a passive TPRN sub-rack.

1. Unpack the kit which includes
   - 1 TLDN
   - 2 RF jumpers (SMA-m), 2 x 40 cm
2. Carefully insert the TLDN module in any of the TPRN sub-rack slots and tighten the 4 screws on the front corners.
3. Connect RF cables to the UL and DL ports, according to what has been planned by the designer. Use an appropriate torque wrench to fix each cable to their relevant ports.

4.7. RF Tri Band Coupler TLTN

Description:

The TLTN is a passive RF tri band coupler designed to combine/split signals coming from different bands.

Its main operations carried out are:

- in downlink, it combines a Low-band signal, a Middle-band signal and a High-band signal onto a single RF path
- in uplink, it filters a composite signal into Low-band, a Middle-band and a Low-band one.

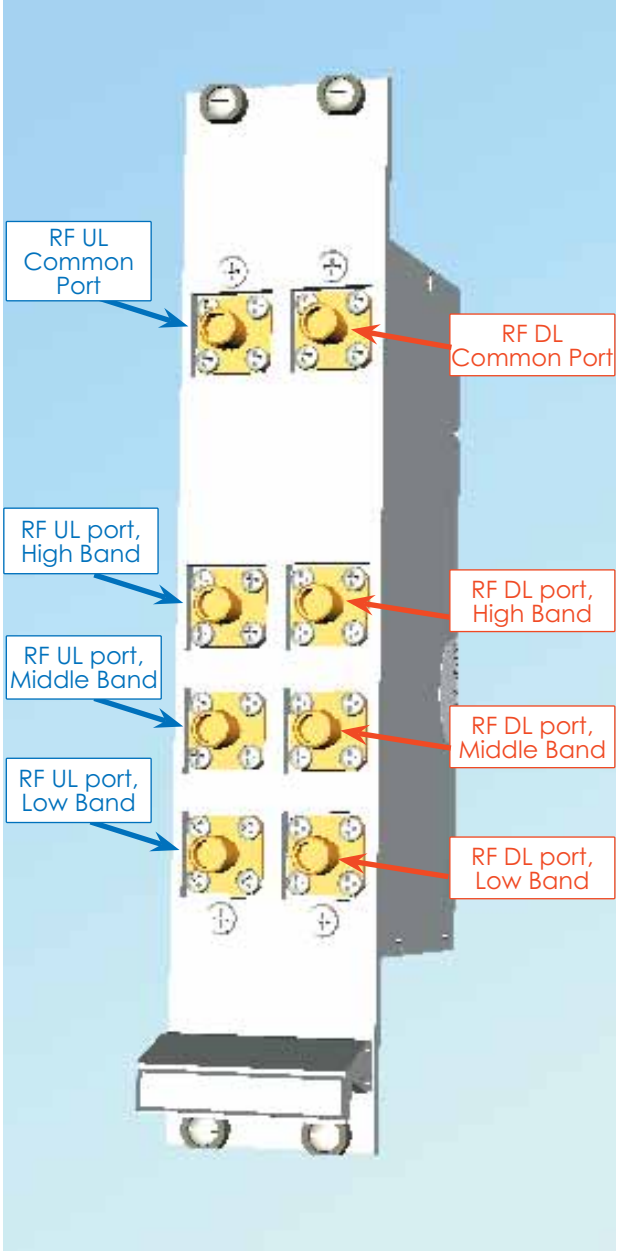


Fig. 4.7.1 TLTN tri-band coupler

TLTN Models

The TLTN tri-band combiner is available in different versions, depending on the bands it addresses. A list of the TLTN models currently available is reported in table 4.7.1:

RF orts

- 1 DL common RF output port ("C") for the combined DL signal
- 1 DL Low-Band RF input port
- 1 DL Middle-Band RF input port
- 1 DL High-Band RF input port
- 1 UL common RF input port ("C") for the combined UL signal
- 1 UL Low-Band RF output port
- 1 UL Middle-BandRF output port
- 1 UL High-Band RF output port

Refer to table 4.7.1 for Low-band, Medium band, High-Band

TLTN Models:	TLTN Ports		
	Low-band	Medium-band	High-band
TLTN 36	DL: 851-869 MHz UL: 806-824 MHz (US LMR800 band)	DL: 935-941 MHz UL: 896-902 MHz (US LMR800 band)	DL: 1710-2170 MHz UL: 1710-2170 MHz (Generic high band)
TLTN 44	DL: 800-1000 MHz UL: 800-1000 MHz (Generic Low band)	DL: 2110-2155 MHz UL: 1710-1755 MHz (US AWS1700 band)	DL: 1930-1995 MHz UL: 1850-1915 MHz (US PCS1900 Extended band)
TLTN 47	DL: 800-1000 MHz UL: 800-1000 MHz (Generic Low band)	DL: 1805-1880 MHz UL: 1710-1785 MHz (EU GSM1800 band)	DL: 2110-2170 MHz UL: 1920-1980 MHz (EU UMTS band)

Table 4.7.1: Different TLTN models

TLTN Main Applications

The main applications of the TLTN module are:

- Connecting 3 donor sources with different services to one TFLN master optical TRX in a tri band system, so that:
  - The TLTN combines the DL inputs coming from 3 different donor sources (carrying different services) into an output signal entering the TFLN master optical TRX
  - The TLTN filters the UL input coming from the TFLN master optical TRX into 3 UL outputs entering 3 different donor sources (carrying different services)

TLTN Insertion Loss

TLTN insertion loss = 3.0 ± 0.5dB

When designing the system, remember to take into account the insertion loss of the TLTN.

Warnings

TLTN

The overall input power must not exceed +27dBm

TLTN Installation

Since the TLTN module doesn't require any power supply it can be housed either in an active or a passive TPRN sub-rack.

1. Unpack the kit which includes:
   - 1 TLTN
   - 2 RF jumpers (SMA-m), 2 x 40 cm
2. Carefully insert the TLTN module in any of the TPRN sub-rack slots and tighten the 4 screws on the front corners.
3. Connect RF cables to the UL and DL ports, according to what has been planned by the designer. Use an appropriate torque wrench to fix each cable to relevant ports.

4.8. RF Duplexer, TDPN

Description:

The TDPN is a frequency-dependent duplexer which combines downlink and uplink signals while maintaining isolation and stability.
This board has been designed to support duplexed Base Stations.

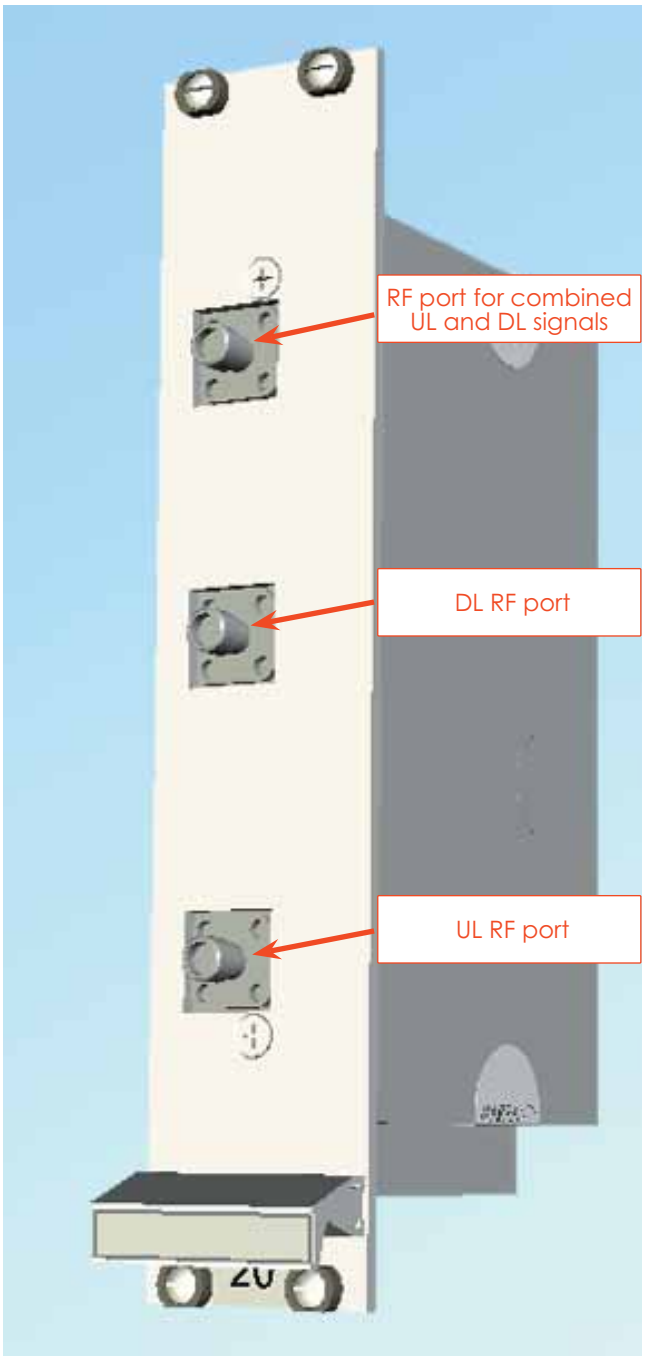


Fig. 4.8.1 TLTN tri-band coupler

RF Ports

- 1 DL RF output port
- 1 UL RF input port
- 1 common RF port ("C") for UL and DL combined signals

TDPN Main Applications

The TDPN main application is to *connect the duplexed antenna port of the donor source to the ION-B system*.
The TDPN splits the DL and UL signals coming from the donor port into two separated ports, while combining the same path in the opposite direction.

TDPN Insertion Loss

The TDPN insertion losses are < 3dB.
When designing the system, remember to take into account the insertion losses of the TDPN.

Warnings

The overall input power must not exceed +30dBm.

As the module is band-dependent, be sure to order the proper single-band version(s).

TDPN Installation

Since the TDPN module doesn't require any power supply it can be housed either in an active or a passive TPRN sub-rack.

1. Unpack the kit which includes
    - 1 TDPN
    - 2 RF jumpers (SMA-m), 2 x 35cm
2. Carefully insert the TDPN module in any of the TPRN sub-rack slots and tighten the 4 screws on the front corners.
3. Connect RF cables to common UL and DL ports, according to what has been planned by the designer. Use an appropriate torque wrench to fix each cable to their relevant ports.

4.9. Base Station Interface TBSI

Description

The TBSI module adjusts the signal level between the donor source and the ION-B system.
It has 2 independent variable attenuators to adjust both the uplink and downlink separately (please refer to the BriteTool manual to understand how to calculate the right value of attenuation through BriteTool software)

RF Ports

- 1 DL RF input port
- 1 DL RF output port (attenuated signal)
- 1 UL RF input port
- 1 UL RF output port (attenuated signal)

The attenuation required for both the DL and UL can be properly set through relevant knobs (30dB range, 1dB step).

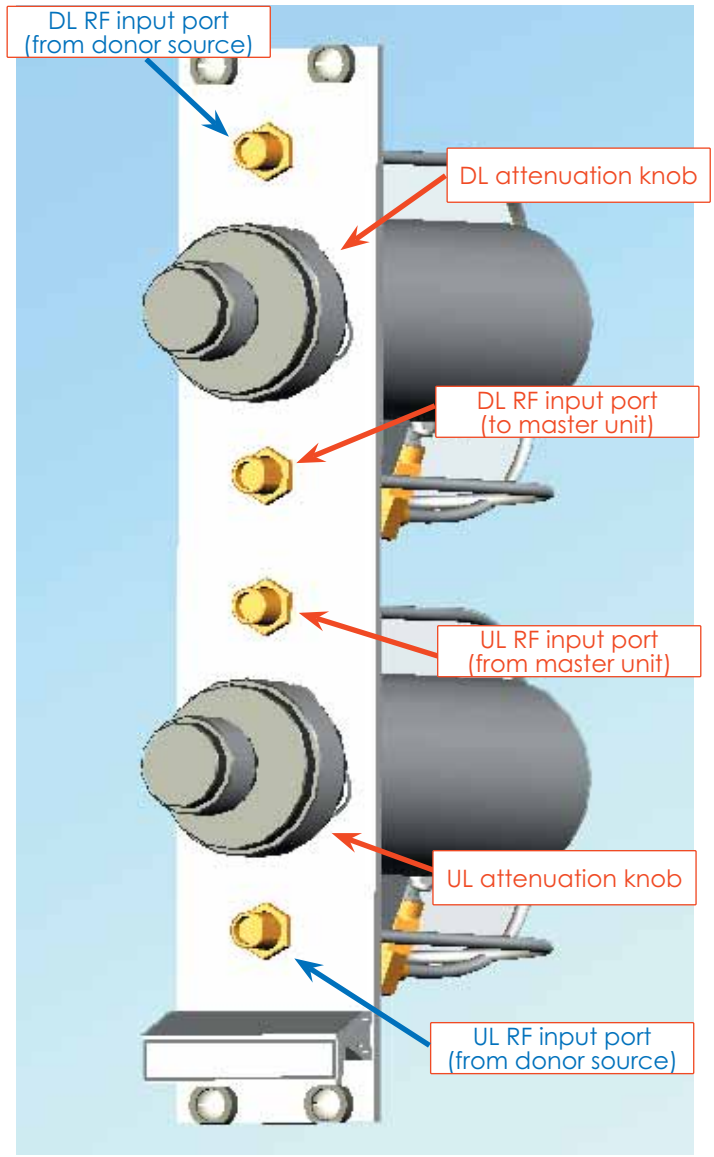


Fig. 4.9.1: The TBSI Base Station Interface

TBSI Main Applications

The main applications of the TBSI module are:

- adjusting RF levels coming to/from a donor source:
  - ➢ The TBSI adjusts the DL signal to meet the required power level at the TFLN DL RF input
  - ➢ The TBSI adjusts the RF UL signal coming from the TFLN master optical TRX in order to meet the desired requirements for blocking level and receiver sensitivity to the donor source

TBSI Insertion Loss

The TBSI insertion losses are described in table 4.9.1:

When designing the system, remember to take into account the insertion loss of the TBSI.

	800 MHz to 2000 MHz	2000 MHz to 2200 MHz
TBSI insertion loss	< 1dB	< 1.3dB

Table 4.9.1: Insertion loss values of the TBSI modules

Warnings

The overall input power must not exceed +30dBm.

TBSI Installation

Since the TBSI module doesn't require any power supply, it can be housed either in an active or a passive TPRN sub-rack.

1. Unpack the kit which includes
   - 1 TBSI
   - 2 RF jumpers (SMA-m), 1 x 35 cm, 1 x 45 cm
2. Carefully insert the TBSI module into any of the TPRN sub-rack slots and tighten the 4 screws on the front corners.
3. Connect RF cables according to what has been planned by the designer. Use an appropriate wrench to fix each cable to their relevant ports.
4. Set proper attenuation values.

4.10. Power Limiter TMPx-10

Description

The TMPx-10 Power Limiter monitors the downlink input power and attenuates it by 10dB above a predetermined set point. The threshold is programmable through the Supervision System.

The TMPx-10 power limiter is available in two versions, one for GSM 900 MHz / DCS 1800 MHz applications, and the other for UMTS 2100MHz.

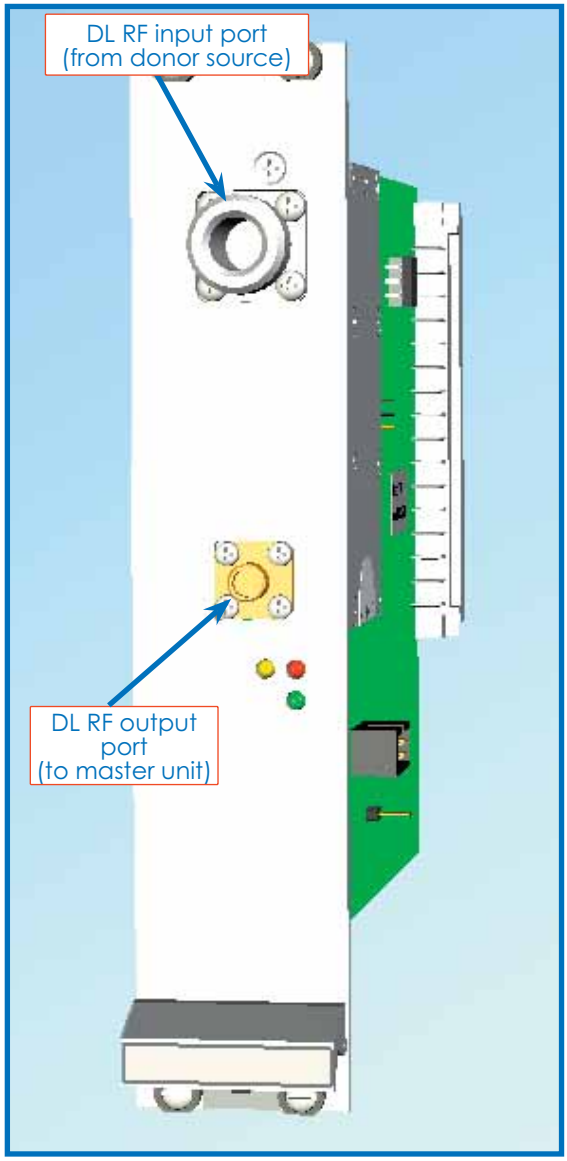


Fig. 4.10.1: The TMPx-10 Power Limiter

RF Ports

- 1 DL RF input port
- 1 DL RF output port

TMP Main Applications

The main applications of the TMP module is:

- Controlling the DL RF level coming from a donor source in order to protect the system if the level exceeds a specified threshold.

TMP Visual Alarms

The TMP front panel is provided with 3 LEDs (please see fig. 4.10.1) showing status and alarm information. The LED meaning is reported in the table below.
Further information about alarm status is delivered by the ION-B Supervision System

Label	LED colour	Meaning
Power	Green	Power supply status OK
Alarm	Red	It can be: - TMP power supply alarm - RF input overdrive
Warning	Yellow	It can be: - temperature alarm - no RF signal at the input port

Table 4.10.1: LED alerts on the TMP front panel

TMP Power Supply

Each TMPx-10 power limiter is supplied by the sub-rack back-plane (+12V).
The power consumption of each TMPx-10 is 2W max.

TMP Insertion Loss

TMP insertion loss < 1.7dB.
When designing the system, remember to take into account the insertion loss of the TMP.

Warnings

The overall input power must not exceed +35dBm.

Inserting or Removing TMP Modules

Before to install the TMP Module

- Do not remove or insert any TMP module into a TPRN sub-rack before having switched off the main power supply.
- The TMP modules must be handled with care, in order to avoid damage to electrostatic sensitive devices.
- When installing TMP modules in the sub-rack, take care to alternate active and passive cards in order to ensure proper heat dissipation.
- In a multi-sub-rack system, remember to assign a proper RS485 bus address to each sub-rack before installing the modules (please refer to the TPRN section for further details).

Setting the GSM 900 MHz / DCS 1800 MHz jumper (only for TMP2-10)

The TMP2-10 module is provided with a 2-pin jumper which allows to choose the proper working mode (GSM 900 MHz or DCS 1800 MHz). Default factory preset is set to DCS 1800 MHz. Before installing the TMP card remember to set the right band, according to the fig. 4.10.2.

Please note that the 2-pin jumper does not affect directly the RF operations, but is absolutely essential in order to evaluate properly the correct power level of the signals, and therefore the provided attentuation!

Therefore, take care to set the 2-pin jumper in the proper position: otherwise, power levels and attenuations will be misevaluated, and a power overdrive or underdrive will occur, although it seems to work propelry at a first glance!

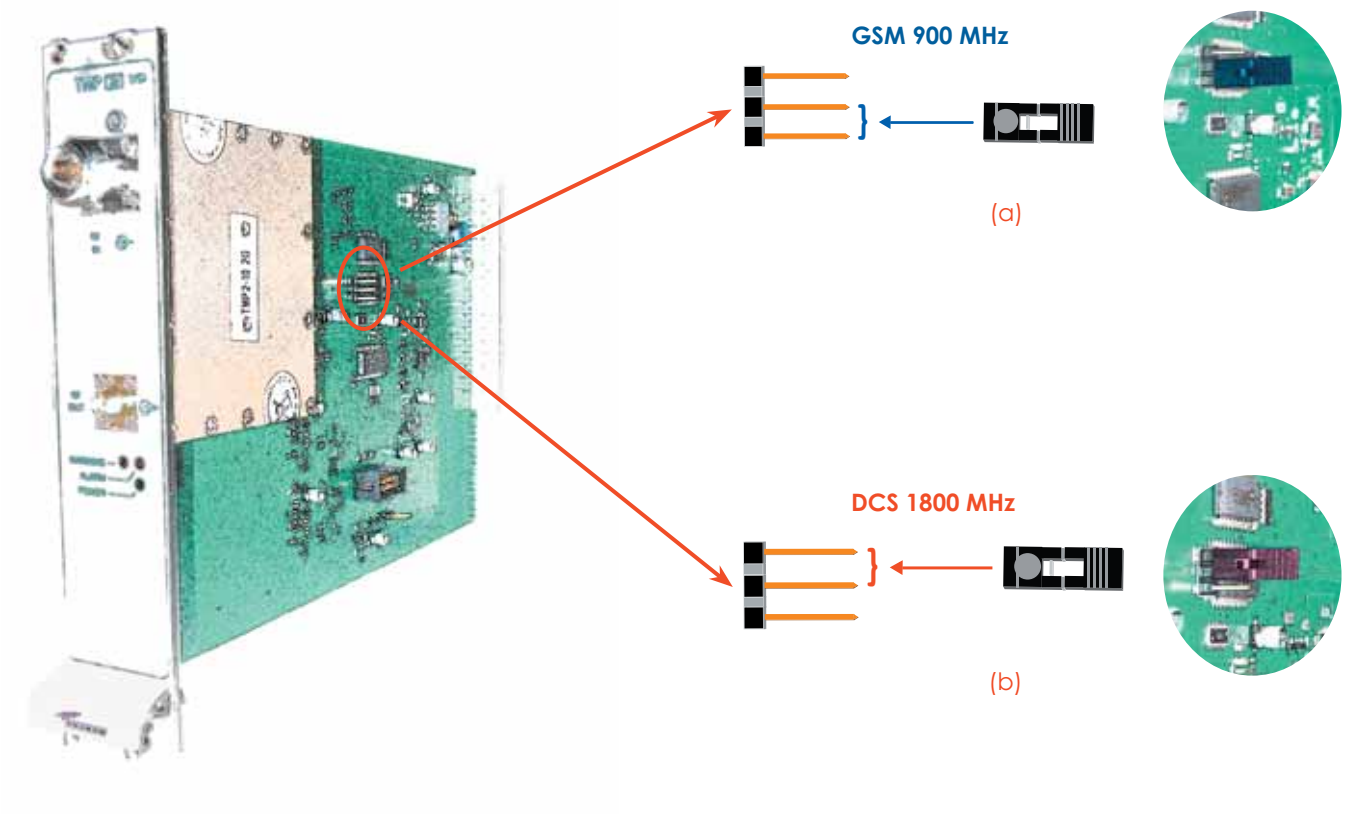


Fig. 4.10.2:
Proper setting of the 2-pin jumper in the TMP2-10 Power Limiter: (a) GSM 900 MHz band ; (b) DCS 1800 MHz band.

TMP Installation

The TMP power limiter can be accomodated in any of the 12 slots of a TPRN active sub-rack.

Note: In case a new TMP module has to be installed in a still working Master Unit, switch off the sub-rack before inserting the plug-in TMP module

1. Unpack the kit, which includes
   - 1 TMP
   - 1 RF jumper (SMA-m), 35cm

   If your card is a TMP2-10, take care to set the 2-pin jumper in the proper working position (GSM 900 MHz or DCS 1800 MHz), according to the figure
2. Carefully insert the TMP module in any of the TPRN sub-rack slots and tighten the 4 screws on the front corners.
3. Connect RF cables according to what has been planned by the designer. Use an appropriate torque wrench to fix each cable to their relevant ports.
4. Switch on the sub-rack. As you switch on the system, carefully refer to the TFLN Start-up section.

Removing a TMP Module

Switch off the Master Unit power supply and remove RF jumpers. Then:

- unscrew the 4 screws and slowly remove the card.
- put the removed TMP card in its safety box.
- switch on the Master Unit power supply again and refer to TFLN Start-up section.

TMP Troubleshooting

In case a TMP power limiter has any problems, this will be easily revealed through LEDs on its front panel. Otherwise troubleshooting can be carried out through the LMT or Supervision System.

ALARM CODE (TSUN description)	ALARM DESCRIPTION	ACTIVE LED	SUPERVISION PRIORITY LEVEL	ACTION RECOMMENDED	RELÉ PRIORITY LEVEL (subrack)
Power supply alarm	UPS HW failure or malfunction. RF is turned OFF	RED	MAJOR	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	YELLOW	MINOR	Check ventilation and environment	MINOR
RF Input overdrive	The input signal has exceeded the threshold	RED	WARNING	Check the RF input signal	MAJOR
RF Input No signal	No RF signal at the input port	YELLOW	MINOR	Check the RF input signal	MINOR

Table 4.10.2: Description of the TMP alarms

The above table reports a brief description of the TMP alarm, together with a reference to the corresponding alerted LEDs.
Understanding why an LED is lit can be done following the troubleshooting procedure reported hereinafter.

Quick Troubleshooting Procedure

(The following procedure is summarized by the flow-chart in fig. 4.2.10)

1. In case the TMP red led is lit and the green led is off there is a problem with the power supply.
    a. Check the TPRN sub-rack and if it is switched off, switch it on.
    b. If the sub-rack is switched on, check the backplane power supply connector to verify if the +12Vdc is provided to the TMP module. If not, there is a fault on the

TPRN backplane and you need to return the sub-rack.

c. Otherwise the TMP power supply section is faulty. Return the unit.

2. In case the TPM red and green leds are lit, the RF level at the input port has exceeded the specified threshold. Decrease the RF signal or change the threshold.
3. In case the yellow led is on, check the RF input level
   a. If there isn't any RF signal at the input, check if the RF cable is connected to the input port. If it's connected, check the power coming out from the donor source.
   b. Otherwise, the temperature range is not within the specified range, change the temperature range or provide proper air flow.

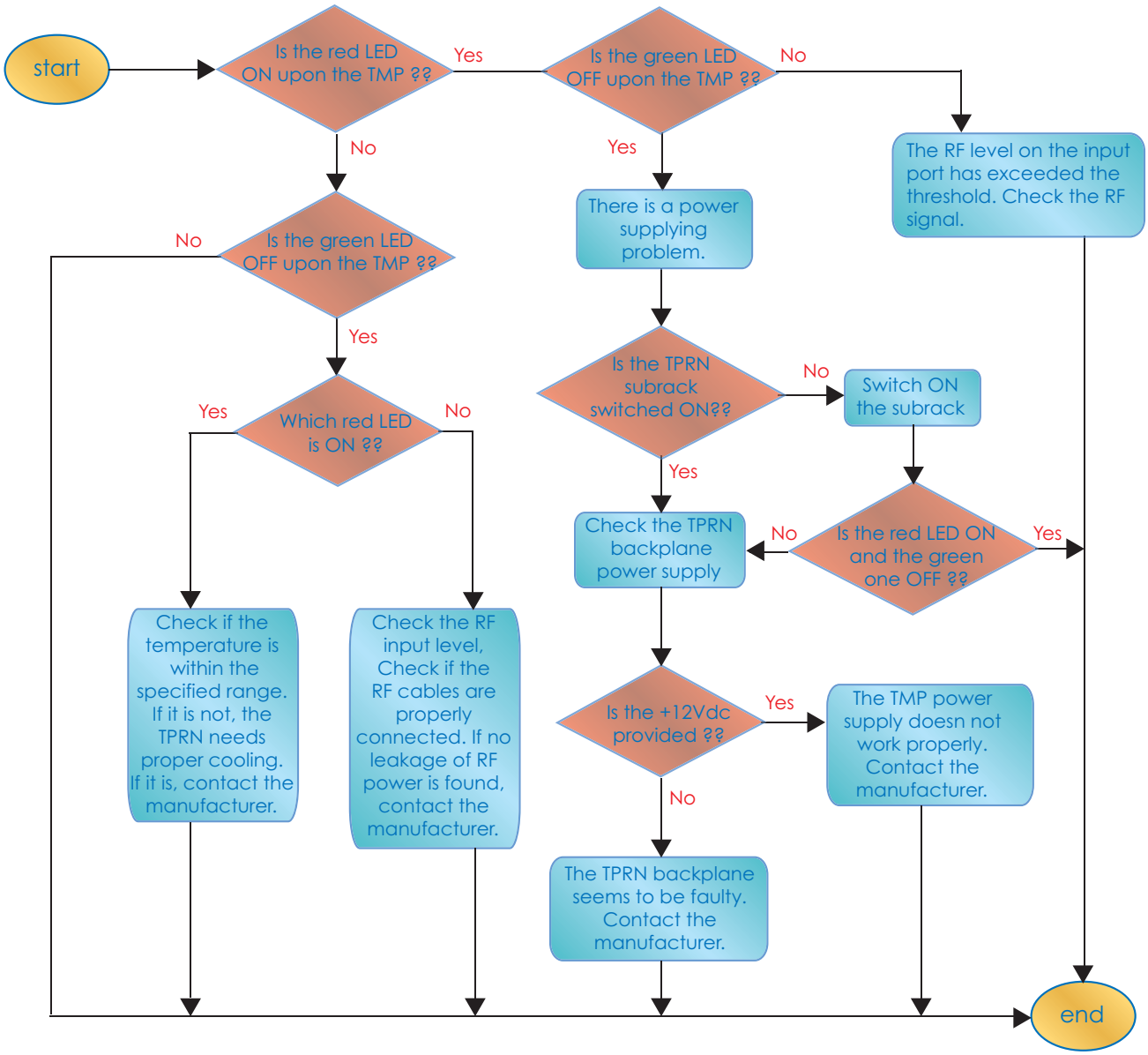


Fig. 4.10.3: Flow-chart describing ordinary troubleshooting procedures on the TMP module

5. Configuration Examples

5. Configuration Examples

5.1 Introduction

Examples of ION-B configurations are demonstrated in the following pages, showing how the equipment is able to meet the demands of a variety of different applications, from the easiest to the most complex.
Some Multi-operator and Multi-sector applications hosted by various ION-B subracks are explored here, as well as a s simple configuration hosted by an ION-B Fast Minirack.

5.2. Multi-Operator Applications

Example #1: a 2-operator configuration, where:

- Operator 1 works with 2 different frequency bands: Band 1, and Band 3.
- Operator 2 works with 3 different frequency bands: Band 1, Band 2 and Band 3.

In this case, Band 1, 2 and 3 correspond to the European band GSM 900 MHz, DCS 1800 MHz, and UMTS 2100 MHz respectively.

The ION-B configuration required for such a scenario is shown in Fig. 5.1, and the corresponding rack configuration is shown in Fig. 5.2.
Please note that:

- any band where more than one Operator is present, requires a Power Limiter module for each operator;
- the entire configuration leads to a 1-sector coverage where all the 3 bands are present, each one served by all the involved operators;
- such a simple configuration allows you to use up to 32 ION-B Remote Units (each one providing 3-band coverage), thus being able to meet the most demanding coverage demands.

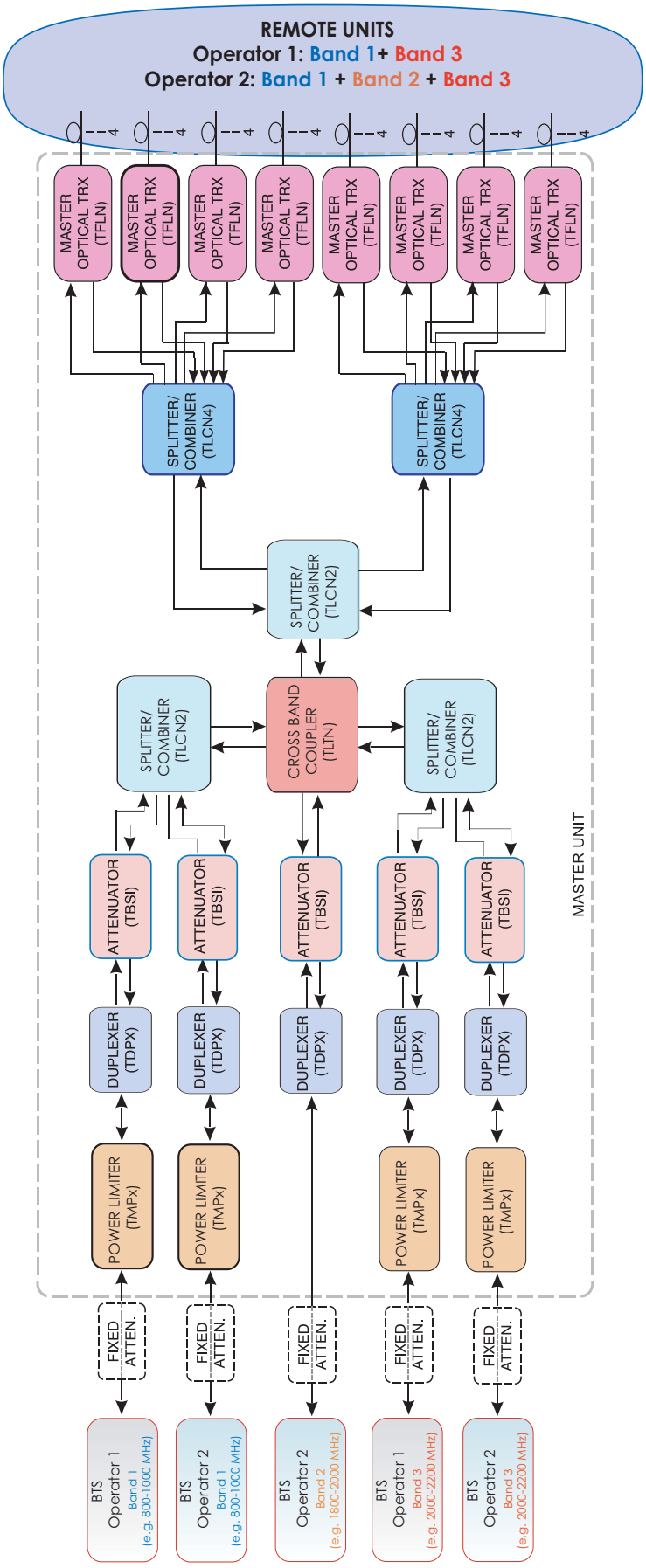


Figure 5.1:
Example of ION-B configurations for a Multi-operator application.

Figure 5.2: Rack configuration for the Multi-operator application shown in Figure 5.1.

5.3. Multi-Sector Applications

For this example, a single operator is present, and 2-sector coverage is required. This configuration reflects a North American scenario, where the coverage needs involve the LMR 800 MHz, LMR 900 MHz, and the PCS 1900 MHz band.
In this case, the entire area must be covered by:

- two LMR sectors (each one served both by the LMR 800 MHz and the LMR 900 bands);
- one PCS 1900 MHz sector.

The ION-B configuration required by such a scenario is shown in Fig. 5.3, and thecorresponding rack configuration is shown in Fig. 5.4. Please note that such a simple configuration allows the use of up to 32 ION-B Remote Units (16 sectors per each LMR sector), thus guaranteeing optimum coverage for the most demanding environment.

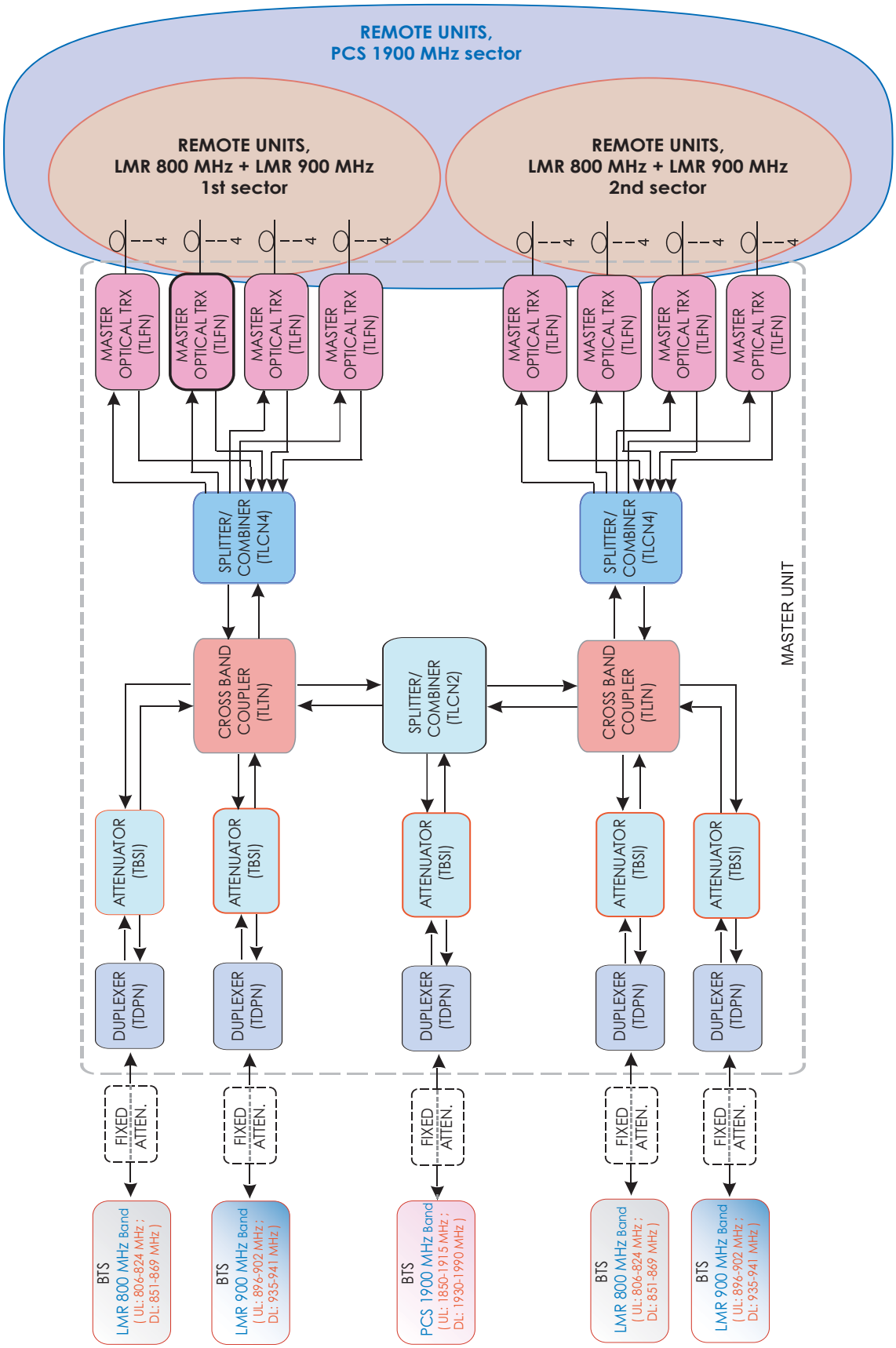


Figure 5.3: Example of ION-B configuration for a Multi-sector application.

Figure 5.4: Rack configuration for the Multi-sector application shown in Figure 5.3.

5.4. Fast MiniRack applications

This last example demonstrates how the ION-B equipment is able to provide a simple solution to a situation where the same operator needs to provide coverage to 1 or 2 frequency bands.

Such a situation can easily be solved by a Fast MiniRack application, housing a Master Optical Transceiver (TFLN) card and the appropriate Point-of-Interface (POI) card, to be chosen among the ION-B 1-slot cards. In order to have the most updated information about the available ION-B 1-slot cards, please contact the referred Salesperson or Product Line Manager.

The ION-B configuration required by such a scenario is shown in Fig. 5.5, and the corresponding rack configuration is shown in Fig. 5.5. Please note that such a simple configuration allows you to use up to 4 ION-B Remote Units, thus guaranteeing good coverage throughout the required area.

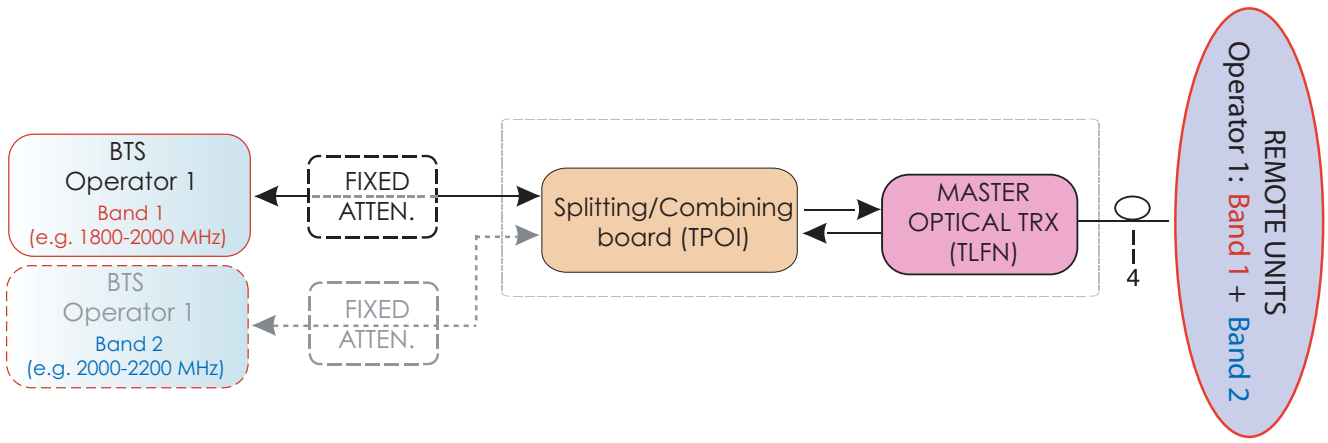


Figure 5.5: Example of an ION-B Fast MiniRack application.

Figure 5.6: Configuration of the Fast MiniRack for the application shown in Figure 5.5.

6. Warning and Safety Requirements

6. Warning and Safety Requirements

Environmental Conditions

This equipment is designed to be installed in indoor environments.
Operating temperature: +5 to +40°C

Do not install in corrosive atmosphere or in critical environmental conditions such as hazardous classified areas [1].

Installation Site Features

A trained technician should carry out the installation of the master unit. Since the system is designed for indoor installation, the master unit should be installed in a dry and suitable location where:

- there is no risk of explosion;
- the environment is not classified as a high-risk one in case of fire;
- suspended particles are not to be found in great concentration;
- there is no risk of traffic which could cause collision damages;
- the site is properly located with respect to the ergonomic positioning of the working environments;
- the system is placed in a private room, protected against any possible violation;
- there is no direct sunlight or where water may drip on the device (for example under air-conditioning equipment).
- the site must be accessible by maintenance personnel;
- the site must be dry, with low humidity;
- the site must guarantee proper space for cables and natural ventilation for the system;
- 2 meters must be kept between the rack and any heating opening.

The remote units should be mounted in reasonable locations as well:

- do not install remote units inside heating or conditioning areas;
- do not install remote units inside cable pipelines or fire-prevention sites (fire escapes, lift tunnelss, emergency exits; which have to guarantee defined safety standards);
- take into consideration that the temperature in the upper part of a room is higher than at the 2 meter height. For false ceiling installation of case-A and case-B remote units, verify that the environment temperatures do not exceed allowed limits;
- each remote unit requires its own power and a connection to the mains might be needed;

- take into consideration that each remote unit transmits an RF signal and the safety volume must be respected (refer to country regulations for safety volume magnitude);
- remote units must be mounted according to installation instructions;
- Weight and dimensions of case-F remote units should be carefully considered when choosing the installation site and positioning. During any installation step, please consider the potential risk of any equipment falling or dropping unexpectedly.
- When choosing the installation site and position, please consider that all remote units must be accessible for tests and maintenance.

[1] Hazardous locations are those areas "where fire or explosion hazards may exist due to flammable gases or vapours, flammable liquids, combustible dust, or ignitable fibres or flyings".

Safety and Precautions During Installation or Maintenance

During installation, the following tools and equipment will be needed:
Typical electrician tools:
cross-point screwdriver, scissors, pliers, nippers, drill and bits, screws for fixing remote units to the wall.
Typical equipment:
proper ladder, scaffolding or air platform for installation of remote units.

CAUTION: some modules are electrostatic-sensitive devices; electrostatic discharges are caused by direct contact or by an electrostatic field. If a charged body approaches an electrically conducting surface, the acquired potential is discharged. An equalising current can than flow in the associated circuitry and generate permanently damaging voltages by induction.
The human body should be grounded at the same potential as the component or equipment being handled. A wrist strap creates an equipotential electrical connection between the object and the human.

CAUTION: Do not paint or otherwise coat ION-B equipment.

CAUTION: Great caution should always be used when installing any equipment at a height higher than 2 meters. Personnel who are installing this equipment should be informed about the possible risks and safety measures when elevated.

CAUTION: Case-F remote units are provided with door panels which must be handled with care during installation or maintenance operations. Always switch off the remote

when working while the panel is open. When closing the panels, take care not to leave any tools inside the equipment, not to hurt your fingers, and not to trap clothes, bracelets, chains, or long hair.
Never remove the cover from a TFAx remote unit or from a TPRN subrack when the power supply is ON.

Power Supply Connection

Power connection must be carried out following all necessary precautions:

- it must be properly made according to the due diligence rules (ex.: EN rules, IEC rules, etc.);
- in accordance with the rules for safety against direct or indirect contacts;
- in accordance with the rules for safety against over current (short circuit, overloading);
- in accordance with the rules for safety against over voltage;
- connection is to be carried out by appropriate and competent staff

CAUTION
In North America, this equipment is to be installed in accordance with the National Electric Code (NEC) ANSI/NFPA 70 and the Canadian Electric Code (CEC) Part 1, C22.1.

CAUTION
Do not remove or insert any module into the TPRN sub-rack without prior switching the power supply OFF.

CAUTION
Do not connect the AC power until you have verified that the line voltage is correct.

Do not remove the plastic cover of the external power supply adapter.

Safety and Precautions for Lasers

The optical transmitter used in the ION-B contains a laser which has a power level that is not dangerous for health. However it is classified as class 1 equipment (in accordance with EN60825). It is nevertheless prudent, during the installation phase, to observe the following rules:

- Never look directly inside the optic connector exit of the transmitter when it is switched on. The wavelength of the laser is not visible to the human eye, which means that long-term damage will not be immediately known.
- When working with the optical connectors, check at each end that both transmitting lasers are switched off.

Health and Safety Warnings

Please be aware that each country or governmental body has established its own specific limits for RF exposure, to which the installation of any radiating antenna must conform. When installing your ION-B system, take care to comply to your local regulations and guidelines about RF exposure limits.
Antenna installation must conform to the following guidelines to meet FCC RF exposure limits, otherwise an environmental evaluation is required if:

RSS Canadian standards

To meet RSS Canadian standards the following guidelines have to be taken into account:

- For any situation where multiple carrier signals are present, take care to reduce the single-carrier output rating at least by 3.5dB, especially when the output signal is reradiated and can cause interference with adjacent band users. This power reduction can be achieved by reducing the input power which enters the TFLN input ports, not through an attenuator at the output of the ION-B devices.
- To comply with the FCC exposure compliance requirements, the following antenna installation and device operating conditions must be satisfied: The antenna(s) used in the system must be installed to maintain at least a 20-cm separation distance from any person. The highest allowed antenna gain, including coaxial cable loss, is 12dBi. RF exposure compliance may need to be addressed at the time of licensing, as required by the responsible FCC Bureaus(s), including antenna co-locating requirements of 1.1307(b)(3).

Electromagnetic Fields and RF Power

The ION-B system generates electromagnetic radiation, which can exceed safety levels in the immediate vicinity of the antenna.

The most widely accepted standards are those developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the Institute of Electrical and Electronics Engineers (IEEE).

Formula for minimum safety distances
The formula for calculating the minimum safety distances uses the specifications of a particular antenna that could be driven by TFAx.

$$r_{min} = \sqrt{\frac{10^{\frac{(G-L)}{10}} P}{4 \bullet \pi \bullet S}} \qquad (6.1)$$

This equation includes the following factors:

- G is the antenna gain (in dB) compared to isotropic radiating antennas;
- P is the RF power that is present at the antenna connector (in W);
- L is the total loss (in dB) between the TFAx remote unit output port and the antenna input port;
- S is the maximum allowed power density in air (in W/m^2). Its values should be calculated according to the limit exposures to time-variations and magnetic fields. The reference values are reported in the ICNIRP guidelines, unless otherwise specified by specific regulations.

(please note that, if regulations only define the maximum electrical and magnetic field strengths, the allowed power density is able to be be obtained by:

$$S= E^2/377= B^2 \cdot 377$$

where 377 is the characteristic's impedance of the empty space).

Example 1. A Medium Power TFAM 18/20P must distribute mobile signals through a directional antenna, fed by a 2-metre length RG223 cable (no splitters used). The antenna gain is 7 dB and the ION-B system distributes one GSM 1800 MHz carrier and one UMTS 2100 MHz carrier.

The maximum allowed power density we have to comply with is:

$$S = 10 \text{ W } m^{-2}$$

(typical ICNIRP reference level for general public exposure to time-varied electric and magnetic fields).

By reading the relevant notes for the TFAM 18/20P remote unit, we know the overall output power at the antenna port is able to be estimated as follows:

- 20 dBm ± 2 (+22 dBm maximum, equivalent to 0.158 W) for the Cellular 850 MHz band
- 20 dBm ± 1.5 (+21.5 dBm maximum, equivalent to 0.141 W) in the PCS 1900 MHz band.
- The total output power at the antenna port is therefore P = 0.158 + 0.141 = 0.299 W.

By reading the cable specs, we get that RG223 cable losses can be estimated at 0.55 dB/m. Total losses between the TFAM 18/20P output port and the antenna input port can therefore be estimated as follows:

$$L = 0.55 \text{ (dB/m)} \times 2 \text{ (m)} = 1.1 \text{ dB}$$

By replacing the above values of G, L, P, S parameters inside the formula 6.1, we therefore get the the following minimum safety distance from the antenna:

$$r_{min} = \{ 10 \cdot \exp [(7 - 1.1) / 10] \cdot 0.299\} / (4 \pi \cdot 10) \} \cdot \exp (1/2) = 0.096 \text{ m}$$

Example 2. A Low Power TFAH85/19 through a directional antenna is used, fed by a 20 -metre length ½" cable, with a 2-way splitter. The antenna Gain is 7 dB and the ION-B system distributes one Cellular 850 MHz carrier and one PCS 1900 MHz carrier.

The maximum allowed power density we have to comply with is:

$$S = 50\ W \cdot m^2$$

(typical ICNIRP reference level for occupational exposure to time-varied electric and magnetic fields)

By reading the ION-B notes, we know that the output power per carrier at the TFAM antenna port is

- 30 dBm ± 2 (+32 dBm maximum, equivalent to 1.202 W) for the Cellular 850 MHz band
- 30 dBm ± 2 (+32 dBm maximum, equivalent to 1.202 W) for the PCS 1900 MHz band

The ½" cable losses are 0.07 dB/m in the 900 MHz band, and 0.11 dB/m in the 2100 MHz band. The splitter insertion losses are 3.5 dB. The total losses between the TFAH85/19 output port and the antenna input ports can therefore be estimated as follows:

$$L_{850MHz} = 0.07\ (dB/m) \times 20\ (m) + 3.5 = 4.9\ dB \text{ for Cellular 850 MHz signals}$$
$$L_{1900MHz} = 0.10\ (dB/m) \times 20\ (m) + 3.5 = 5.5\ dB \text{ for PCS 1900 MHz signals}$$

The term "10 exp (G-L/10) P" which appears inside the formula 6.1 should therefore be calculated seperately for each frequency, and then added in order to calculate the composite contribution:

$$P_{850MHz,\ ant} = 10 \exp [(7-4.9)/10] \cdot 1.202 = 1.949\ W$$
$$P_{1900MHz,\ ant} = 10 \exp [(7-5.5)/10] \cdot 1.202 = 1.698\ W$$
$$P_{composite} = P_{850MHz,\ ant} + P_{1900MHz,ant} = 3.647\ W$$

By dividing the total power through $(4 \cdot \pi \cdot S)$ and taking the square root according to the formula 6.1, we therefore get the the following minimum safety distances from the antenna:

$$r_{min} = \{ P_{composite} / (4 \cdot \pi \cdot 50) \} \cdot \exp (1/2) = 0.02\ m$$

Example 3. There is a Medium Power TFAM91/18/20 which is connected to an omnidirectional antenna through a 10-metre length RG223 cable (no splitters used). The antenna Gain is 7 dB and the ION-B system distributes two GSM900 carriers, two GSM1800carriers, and one UMTS2100 carrier.

The maximum allowed electrical field strength is:

$$E = 6\ V\ m$$

(typical Italian reference level for exposure to time-varied electric and magnetic fields). The corresponding value of the maximum allowed power density is:

$$S = E^2/377 = 0.1\ W/m^2$$

By reading the relevant notes for the TFAM 91/18/20 remote unit, the overall output power at the TFAM antenna port can be estimated as follows:

- 20 dBm ± 2 (+22 dBm maximum, equivalent to 0.158 W) for the Cellular 910 MHz:
- 21 dBm ± 2 (+23 dBm maximum, equivalent to 0.200 W) for the GSM1800)

- 26 dBm ± 1 (+27 dBm maximum, equivalent to 0.501 W) in the UMTS band
- The total output power at the antenna port is therefore:
  P = 0.158W x 2 + 0.200W + 0.501W = 1.345 W,

By reading the cable specs, we get that RG223 cable losses can be estimated at 0.55 dB/m. Total losses between the TFAM 91/18/20 output port and the antenna input port can therefore be estimated as follows:

$$L = 0.55 \text{ (dB/m)} \times 10 \text{ (m)} = 5.5 \text{ dB}$$

By replacing the above values of G, L, P, S parameters inside the formula 6.1, we therefore get the the following minimum safety distance from the antenna:

$$r_{min} = \{ 10 \cdot \exp [(7 - 5.5) / 10] \cdot 1.345\} / (4 \cdot \pi \cdot 0.1) \} \cdot \exp (1/2) = 1.22 \text{ m}$$

Warning Labels

CLASS 1 laser product

GROUND - Use this terminal for a safety ground connection for the equipment.

When this equipment is no longer used, please do not throw it into a trash container as unsorted municipal waste. Waste electrical electronic equipment (WEEE) must be collected apart and disposed of according to the European Directives 2002/96/EC and 2003/108/EC. In order to comply with the proper WEEE disposal, it is suggested that you contact the manufacturer. Any failure to comply with the above regulations will be punished through fines

Please refer to Appendix B for further details about equipment disposal

7. TECHNICAL SUPPORT

7. TECHNICAL SUPPORT

Andrew Corporation offers technical support by providing these 24-Hour call services:

North America (toll free) to U.S.A.
Telephone 1-800-255-1479
Fax 1-800-349-5444

Any Location (International) to U.S.A.
Telephone + 1-779-435-6000
Fax + 1-779-435-8576

The ION-B is developed by:

Andrew Wireless Systems Srl
Via Pier De Crescenzi 40
48018 Faenza, Italy
Tel: +39.0546.697111
Fax: +39.0546.682768

Useful information about the product is available on Andrew's website:

http://www.andrew.com/products/inbuilding/das/ion_b-series.aspx

For further information about the product, please write to:

Britecell@andrew.com

For questions, comments or suggestions, go to following page on Andrew's website:

http://www.andrew.com/contactus/contact.aspx?ct=11

Returning Equipment

Before returning any equipment to the manufacturer for repairation or replacement, the customer should give prior notice to the manufacturer and ask for the 'Return Material Authorisation' (RMA request).
Before sending any piece of equipment to the manufacturer, the following RMA request form is required to be sent via fax (+39 0546 682768) or via e-mail (Britecell@andrew.com).

RMA REQUEST FORM

Company name	
Address	
Contact person	
Invoice number	
Delivery note	
N°. of pieces	
Model[1]	
Serial Number[1]	
Lot[1]	
Year[1]	
Description of the Failure/defect	

[1]*Please refer to the serial label*

Upon accepting your RMA request, the manufacturer will assign you a unique RMA code. You will therefore be able to return the equipment to the manufacturer. Please remember that:

- each piece of equipment must be packaged with care before shipment;
- a copy of the RMA request form must be included with the returning equipment, with clear indication of the RMA code you received from the manufacturer.

The returned pieces are able to be repaired (where possible) or replaced (when no repairations can be carried out). These operations are performed under warranty (please see the warranty conditions specified in the sales contract) or out-of-warranty. In the latter case, we will send you a bill for equipment repairation or replacement.

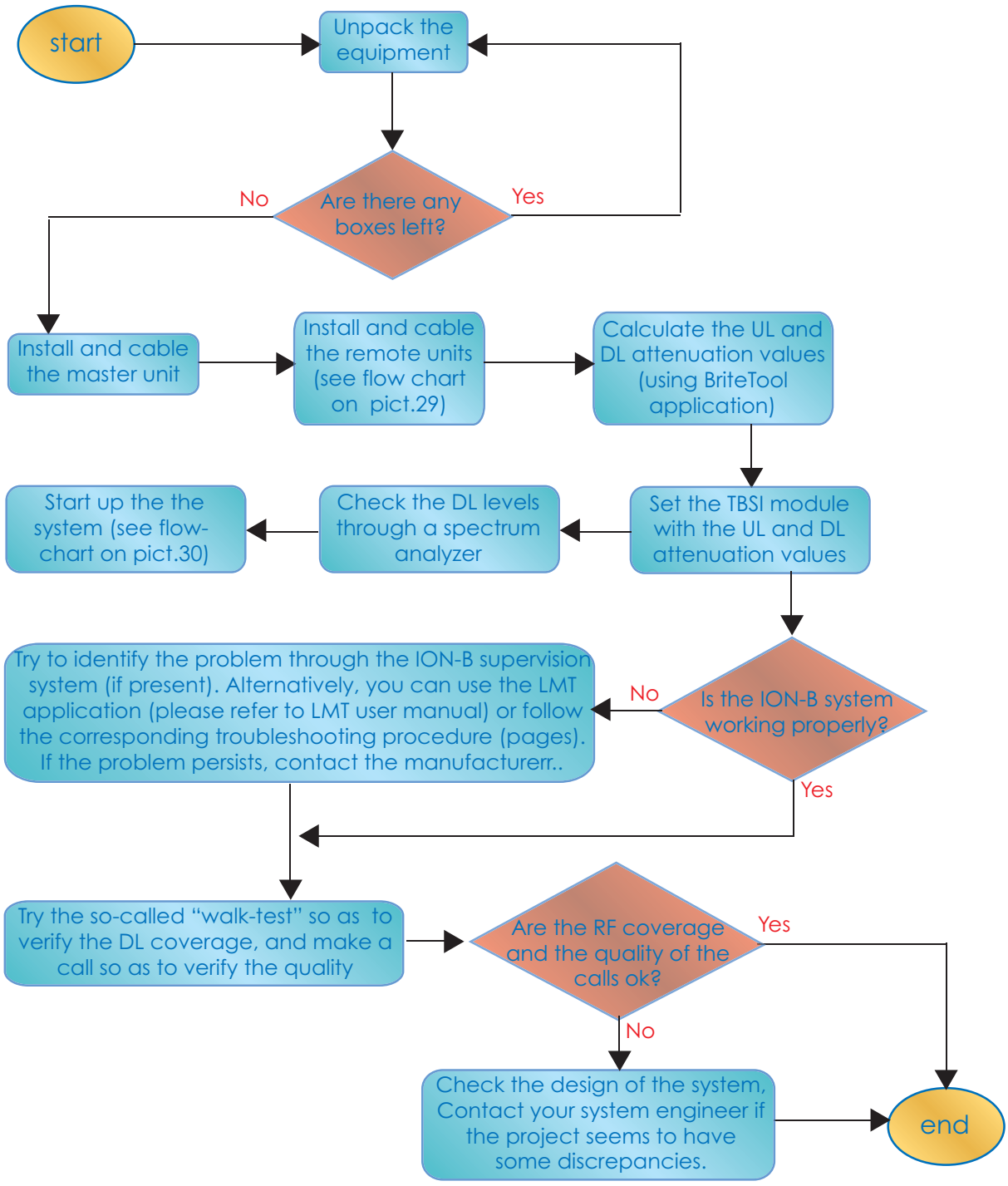
When returning the repaired or replaced equipment, the manufacturer will issue a check report, which will be included in the packaging together with the returned pieces. The customer will be informed of any corrective actions suggested for quality assurance.

Appendixes

Appendix A: System Commissioning

The following flow charts are a quick reference for the ION-B® system installation and commissioning.

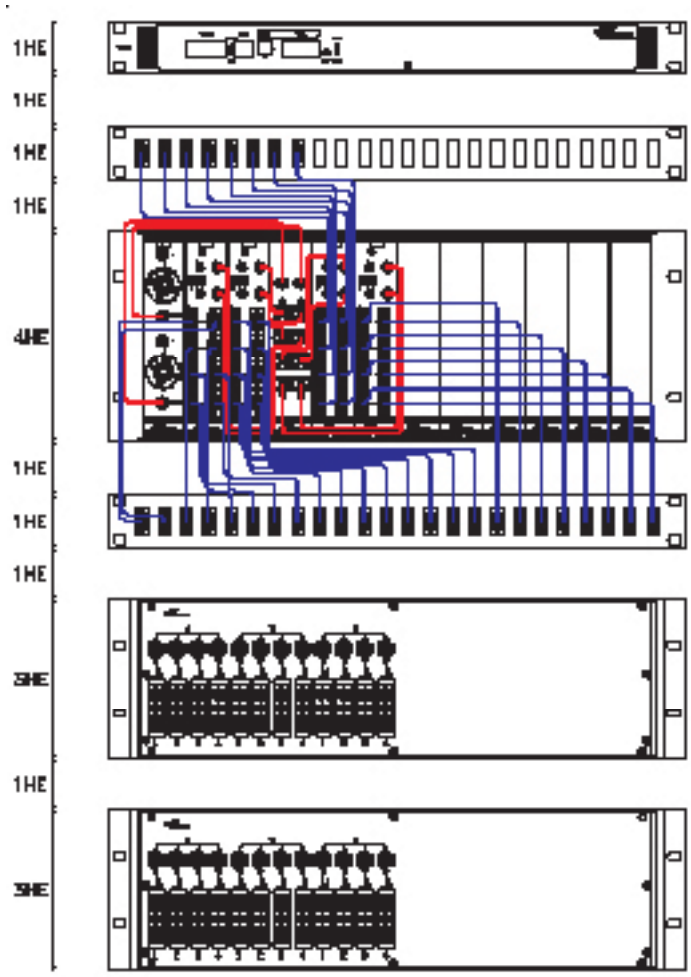
The first flow chart (see Fig. A.1) highlights the main steps for system installation and commissioning starting from the equipment unpacking up to the check of the coverage and call quality.



Picture A.1: Flow-chart describing the main istallation and commissioning steps

The previous flow chart contains the following cross references:

- the master unit installation and cabling is described in more detail in the flow chart (Fig. A.3). It follows the flow of actions from the sub-rack mounting on the cabinet up to the settings and connections needed in case remote supervision has to be considered.
  An example of system layout at master unit side is presented in figure A.2 for a configuration consisting in 1 sector with 4 TFLN master optical Trxs.
  For more details about TSUNx configuration and start-up refer to the Remote Supervision manual.

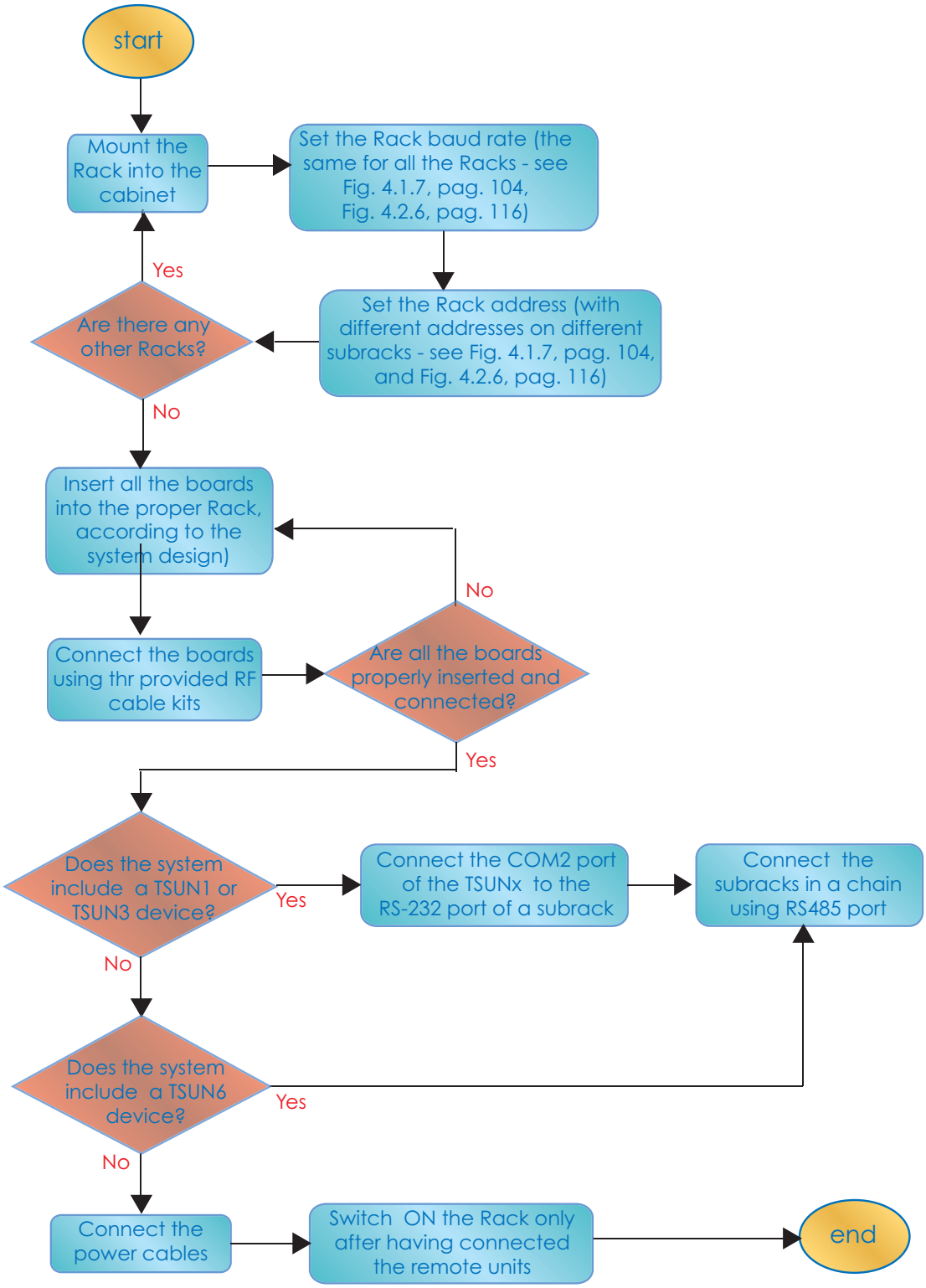


Picture A.2: Case layout for a 1 sector with 4 TFLN master optical transceiverss

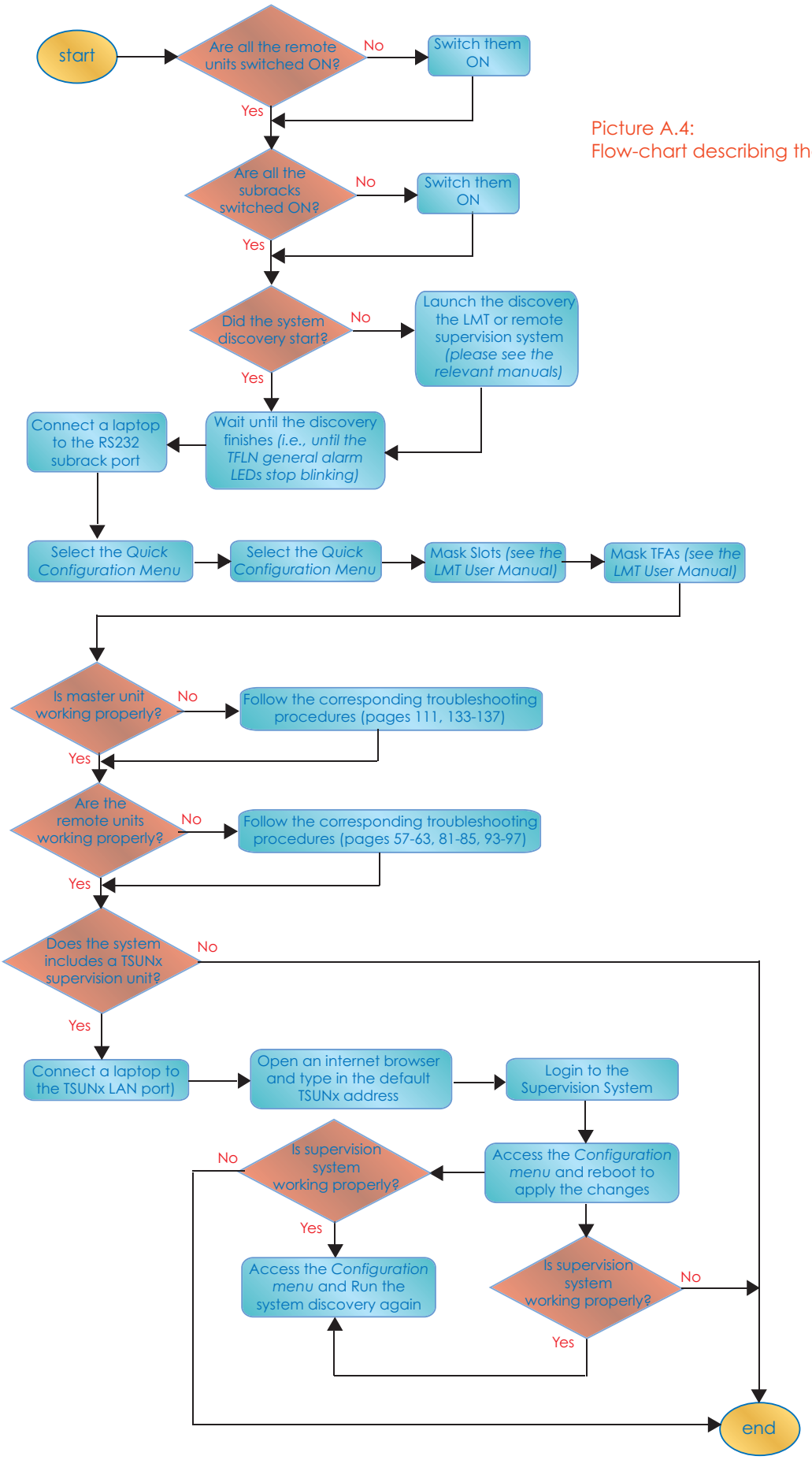
- once the whole system has been installed, the attenuation on the base station interface has to be defined in order to set up the performances. Use the Britetool Software to calculate the required attenuation values for uplink and downlink. Refer to the Britetool manual for more information.
- the system start-up is described in more detail in the flow chart (Fig. A.4). It follows the flow of actions from the remote and master unit switch on and discovery up to the system

configuration through LMT Software and/or remote supervision system.
For more details on how to use the LMT and about TSUNx configuration and start-up refer to their relevant manuals.

- in case the system is not working properly, refer to the troubleshooting procedures reported in their relevant sections.



Picture A.3: Flow-chart describing the Master unit installation and cabling steps



Picture A.4:
Flow-chart describing the system start-up steps

Appendix B:
EU Guidelines for WEEE Disposal

Disposal Guidelines

All WEEE products are properly labelled (please refer to fig. B.1) so as to inform the customer that no piece of equipment should be treated as unsorted municipal waste. Within the EU boundaries, any WEEE equipment which is no longer used should be treated and disposed of according to European Directives 2002/96/EC and 2003/108/EC. The above regulations state that Waste Electric Electronic Equipment (WEEE) must be disposed of by authorised centers with proper license for WEEE treatment.

The customer can decide to dispose of the unused equipment only if he owns a WEEE disposal licence. Otherwise, he should contact the manufacturer or any center which is authorised for WEEE treatment. Any failure to comply with the above regulations will be punished through a penalty whose amount and terms are set by each EU Member State.

The information reported hereinafter (table B.1) is aimed at allowing the costumer to recycle and dispose of the WEEE equipment according to environmental-friendly practices. These guidelines fall within Andrew's efforts to increase re-use, recycling and other forms of recovery, leading to a reduction in the amount of waste going to landfill or incineration

Fig. B.1: WEEE identification label

Products	Recyclable materials	Waste to be disposed of by approved companies (i.e, licensees for European Waste No. 160216)	Hazardous materials
TFAx Case A **TFAx Case B**	• Alluminium (external case) • Metal (RF connectors,screws, bottom cover) • Plastic (optical connectors and adapters, dry contacts)	• cables, fiberoptic cables, internal circuit boards • psu, inlet (for any TFAx Case A, except TFAM20)	• None
TFAx Case R **TFAx Case R2**	• Alluminium (external case) • Metal (RF connectors, screws) • Plastic (optical connectors and adapters ; power connector;)	• cables, internal circuit board	• None
TFAH Case F	• Alluminium (external case) • Metal (RF connectors, screws, cavity filters) • Plastic (optical connectors and adapters ; power connector;)	• cables, fiberoptic cables, internal circuit boards, psu, inlet	• None

Products	Recyclable materials	Waste to be disposed of by approved companies (i.e., licensees for European Waste No. 160216)	Hazardous materials
TPSN Power Supply	• Plastic (external case; inlet and plug in the 220 Vac version) • Metals (wall bearing; screws)	• cables, fiberoptic cables, internal circuit boards, psu, inlet	• Electrolytic capacitors
TKA installation kit	• Alluminium (wall bearing) • Metal (connector cover)	• None	• None
TPRN	• Alluminium (external case) • Metal (screws, bottom cover) • Plastic (black guides housing the modules)	• cables, internal circuit boards, psu, inlet	• None
TPRF31	• Metal (RF connectors, screws) • Plastic (power supplying ports, power connector, dry-contacts)	• cables, fiberoptic cables, internal circuit board	• None
TFLN	• Alluminium (front panel) • Metal (RF connectors, screws) • Plastic (optical connectors and adapters ; side protections of the electronic board)	• cables, fiberoptic cables, internal circuit board	• None
TLCN2, TLCN4, TLDN, TLTN, TDPX, TMP	• Alluminium (front panel) • Metal (RF connectors, screws)	• cables, internal circuit board	• None
TBSI	• Alluminium (front panel) • Metal (RF connectors, screws) • Plastic (handles on the TBSI front panel)	• cables, internal circuit board	• None

Table B.1:
Guidelines for recycling and disposing of ION-B electrical and electronic components