ANDREW®

BRITECELL™ PLUS

User Manual

MN024-08

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1. Introducing Britecell Plus

1.1 The Features

Britecell Plus 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, Britecell Plus is the perfect plug&play solution to distribute any wireless standard (including GSM, GPRS, EDGE, CDMA, WCDMA, and WLAN IEEE 802.11b) 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 Britecell Plus 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 Britecell Plus

Britecell Plus 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.

Britecell Plus 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 Britecell Plus options), in order to meet the planned design requirements;
- 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. Britecell Plus is fully compatible with any type of indoor antennas;
- the optical cables required to connect the 19” subracks to the TFAx.

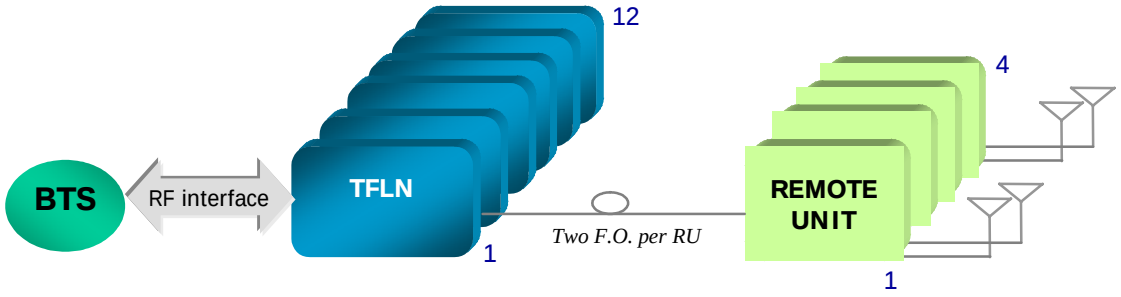


Fig. 1.1: Britecell Plus system block diagram.

1.3 Britecell Plus Features

The following lines report a brief summary of Britecell Plus main features:

- **multiband 2G, 2.5G and 3G – 802.11b WLAN compatible:** Britecell Plus 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 Britecell Plus 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 Britecell Plus 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, Britecell Plus 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 Britecell Plus 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 Britecell Plus 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, Britecell Plus 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 can be arranged so as to get the best fit for customers needs. Britecell Plus equipment provides RF splitters/combiners, cross band couplers, attenuators, duplexers for UL/DL paths, thus allowing the maximum design flexibility;
- **high reliability**: high MTBF (Mean Time Between Failure).

1.4 Britecell Plus typical Applications

Thanks to its unique features Britecell Plus is the ideal solution to set up radio coverage in may situations:

- **Multi operator shared infrastructure**: each mobile operator has its own carriers, which must be transported without affecting the others. Britecell Plus is capable of transmitting multiple carriers simultaneously, while providing an independent level adjustment 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 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 an indoor to an outdoor coverage.
- **Exhibition, conventions, and shopping centres**: the critical point of these environments is due to the high traffic loads, which are furthermore highly variable. Thus, the main goal to achieve is setting up a radio coverage which could effectively manage these variable traffic loads, with neither undervalued nor overvalued infrastructure expenses. A unique feature of Britecell Plus is that RF frequencies can be allocated quickly when and where they are needed, thus reducing the implementation cost. This makes Britecell Plus the proper solution also for temporary or last minute requests (such as conferences).
- **Airports**: they require modular and flexible radio coverage, in order to meet present needs while foreseeing future expansions. Britecell Plus can manage high traffic loads providing high quality with minimum environmental impact, while its modularity allows future extensibility.
- **Corporate Building**: inside a corporate building, difficult mobile communications may limit business transactions. These environments are often complex and densely populated with specific requirements to be fulfilled: high traffic capacity, maximum expectations on Quality of service, full compatibility with wireless standards and future expandability. Britecell Plus guarantees high quality radio coverage

under all conditions, while maintaining maximum flexibility in managing any traffic condition.

- **Subways and Highly Dense Metropolitan Areas:** These areas are distinguished by large distances, and may require that RUs are placed far away from the BTSs. Britecell Plus guarantees the signal integrity at distances up to 3 km, and through the wideband interconnect link option distances of 20 km can be reached. Moreover, these environments need gradual investments, because initially operators provide radio coverage only in the busiest areas, and then extend it in order to reach complete coverage. The modularity of Britecell Plus helps operators to gradually expand the system. Some large cities often need to set up seamless and reliable radio systems for emergency services. The required RF infrastructure needs to be unobstrusive and environmental friendly; this can be achieved using a Britecell Plus DAS. When redundancy is required, two interleaved Britecell Plus 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

2.1. Introduction

Basically, a Britecell system is composed of:

- a Master Unit, able to bring mobile radio signals from the BTS to different remote units and vice-versa, so as to remotise the distribution and collection of any mobile and wireless signal;
- a variable number of Remote Units, conveying and receiving mobile signals by low-power antennas.

We hereby will provide a brief introduction to the main components of the Master and Remote Units which make up the Britecell system, while further details about each component will be given in the next sections of the present manual.

2.2. The Britecell Plus Remote Unit and its relevant accessories

The **Remote Unit (TFAx)** is a device providing optical-to-electrical downlink conversion and electrical-to-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 A, Case B, Case F and Case L), so as to fulfil different coverage and band requirements.

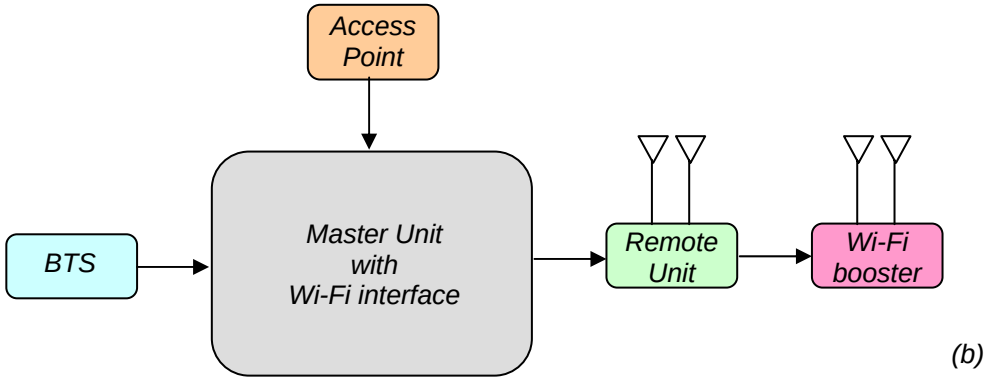
Fig.2.1: Different Remote Unit cases

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 a RF signal from remote antennas, provides a RF-to-optical conversion, and conveys the converted signal to the Master Unit through optical fibres.

Power supply (available either in 90÷264 Vac or in -72÷-36 Vdc version) is internal in Case L, in Case F and in most Case A remote units: vice-versa, all Case B and some Case A remote units are provided with an external power supply (TPSN), whose dimensions are shown in table 2.1(a).

The **TFBW** unit is a **booster** which can be cascaded with a TFAx in order to distribute Wi-Fi signals (802.11b and g) through dedicated Wi-Fi antennas (see scheme 2.2b).

(a)



(b)

Fig. 2.2 (a) TFBW booster ; (b) block diagram of a Britecell Plus system with Wi-Fi Interface

The case-A and Case-B Remote Units and the TFBW boosters can be provided with the **TKA installation kit** (optional), which contains a fiber optics splice holder and a compact case, in order to allow an easy installation on walls or poles. TKA compact cases allow different IP protection levels, depending on the specific environmental requirements.

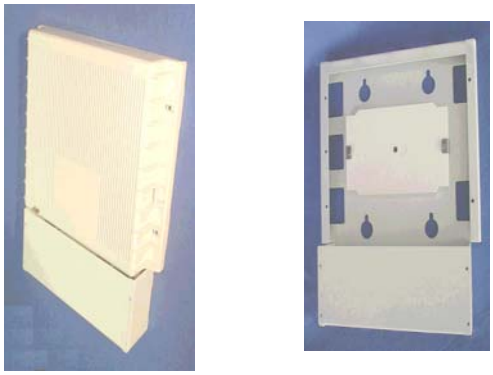


Fig. 2.3: TKA mounting kit for Case A and Case B remote units

2.3. The Britecell Plus Master Unit

The Britecell Plus Master Unit is a widely-flexible system. It is available both as a stand-alone version (the Fast Master Unit) and as a rack-based version. In the followings we will give a brief overview of the components of these units.

2.3.1 The Fast Master Unit

The Master Fast (TFLF): designed into a stand-alone mechanical case, it includes all required ancillary and support functions. It is available in various frequency ranges, from 800MHz up to 2200MHz and allows feeding up to 4 Remote Units.
Module dimensions: 240 x 200 x 38mm

Fig. 2.4: The Fast Master Unit

2.3.2 The rack-based Master Unit

The Sub-rack (TPRN) is a 19" subrack hosting the Britecell Plus modules; it accommodates 12 slots, whose sizes are 7TE x 4HE. As each Britecell Plus module takes up one or two slots, each Master Unit can sustain up to 12 modules, depending on design configuration and requirements.

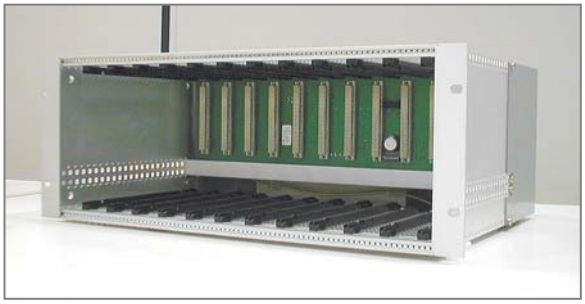


Fig. 2.5: The TPRN Subrack

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 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).

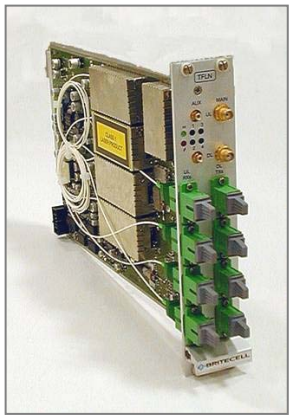


Fig. 2.6:
The TFLN Master Optical TRX

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

Fig. 2.7:
The TDPX duplexer

The variable RF attenuators (TBSI): it 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. 2.8:
The TBSI variable attenuator

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. 2.9:
The TLDN tri- band coupler

The tri band coupler (TLTN): in downlink it combines the low band signals (800 or 900MHz), the 1800MHz band signal and 2000MHz signal into a common one; in uplink it splits the triple band signal between three different RF single band paths. Module dimensions are: Width = 7 TE, Height = 4 HE.

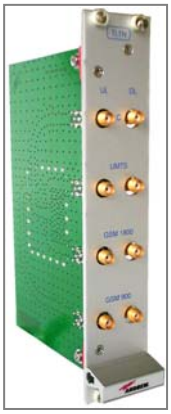


Fig. 2.10:
The TLTN tri-band coupler

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

Fig. 2.11: The TLCN2 and TLCN4 splitters/combiners

The WLAN interface board (TWLI):.it connects 3 WLAN Access Points to each TFLN, and it is necessary when 802.11b/g WLAN distribution through the DAS is required. Dimensions: Width = 14 TE, Height = 4HE (2 slots in the master unit sub-rack).

Fig. 2.12:
The TWLI Wi-Fi interface board

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

Fig. 2.13:
The TMPx-10 power limiter

The ***interconnect-link (TILx)*** is a multi-module kit which allows to expand our system by connecting an additional Britecell Plus subrack station to the main one, at a distance of up to 20 km. In details:

- The TDTX and TMRX cards make up the “master side” of the i-link; thus, they have to be housed inside the main Britecell Plus subrack, and take 1 slot each;
- The TDTX and TSRX cards make up the “slave side” of the i-link; thus, they have to be housed inside the remotised Britecell Plus subrack, and take 1 slot and 3 slots respectively.

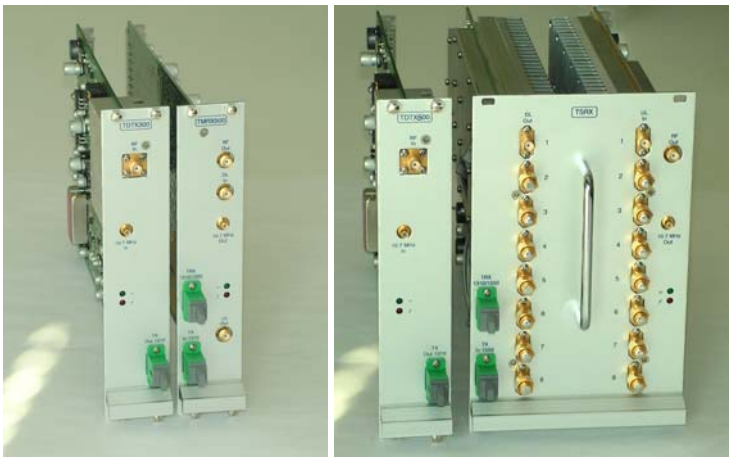


Fig. 2.14: The TILx interconnect link (i-link)

The TILx kit is available either in simple (TILx-HL) or in WDM (TILx-HLW) version.

The remote supervision unit (TSUN): it is able to control up to 14 master units fully populated. It is available both as a plug-in module (Width = 14 TE, Height = 4HE, 2 slots in the master unit sub-rack) and as stand alone device (Width= 19”, Height=1HE). It consists in a CPU, a flash memory and an Interface Board

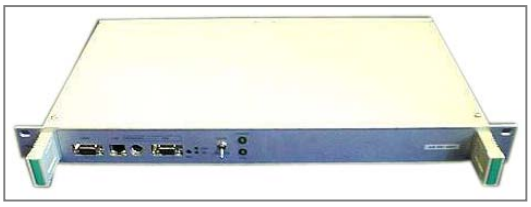


Fig. 2.15: The TSUN remote supervision unit

The Remote Power Unit (TRS/TRSN): it is a sub-rack unit (whose sizes are 7TE x 4HE) providing remote power supply to up to 24 remote units through standard AWG14/16 copper lines. It is available in 2 versions:

- The *TRSN* version is able to supply 1 A per port and it can feed all remote units.
- The *TRS* version is able to

Fig. 2.16: The TRSN subrack

supply 0.5A per port: it can feed only single and dual band TFAN remote units, as well as the TFAM20 one.

2.4. Block diagrams

In order to better understand the functionalities of the different units and modules, some block diagrams of the Britecell Plus system are reported hereafter.

Systems based on Fast Master Unit must be directly connected to the BTS station. The scheme of a typical Fast Britecell system is reported here in fig. 2.17.

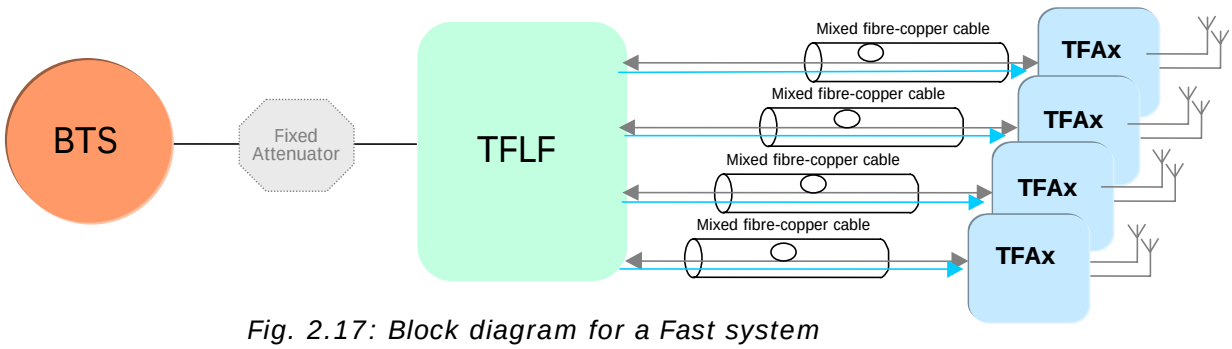


Fig. 2.17: Block diagram for a Fast system

A more complex distribution system requires a rack-based Master Unit. It allows the employment of a splitting/combining section (built by some passive modules TLTN, TLDN, TLCN, and TBSI described above) in order to interface one or more BTSs with several TFLN optical TRXs and with an higher number of TFAx remote units.
Firstly, let's assume that our BTSs are not duplexed. In this case, no TDPX module (see fig. 2.7) is required. Moreover, let's assume that the Master Unit is made up of one or more subracks located in a single site, so that 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 2.18.

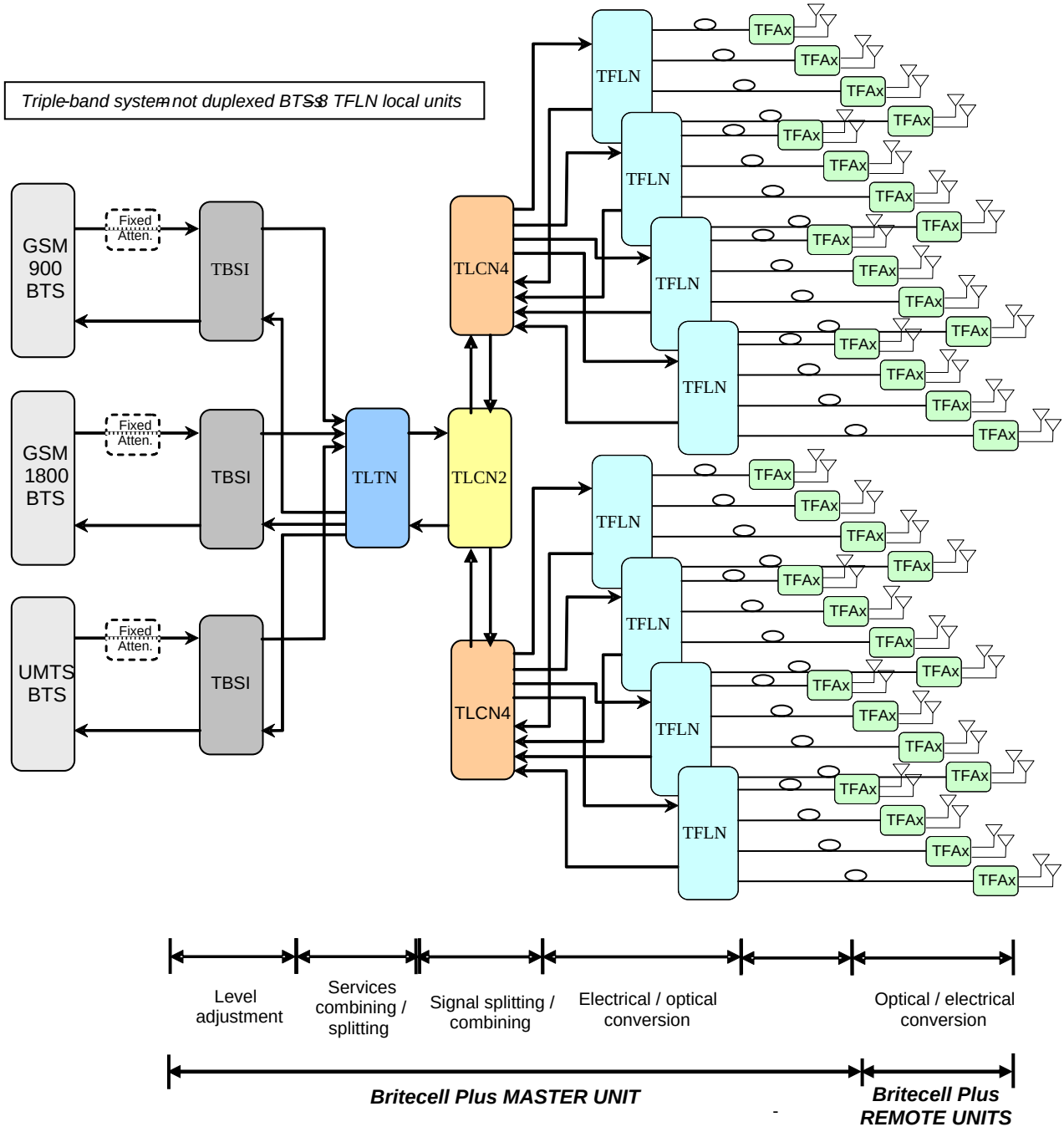


Fig. 2.18: Block diagram for a triple-band system with not-duplexed base stations. This scheme involves a rack-based Master Unit, with 8-TFLN optical TRXs and 32 TFAx remote units.

Now let's consider the same network configuration, but with duplexed BTSs. In this case, some TDPX 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 2.19.

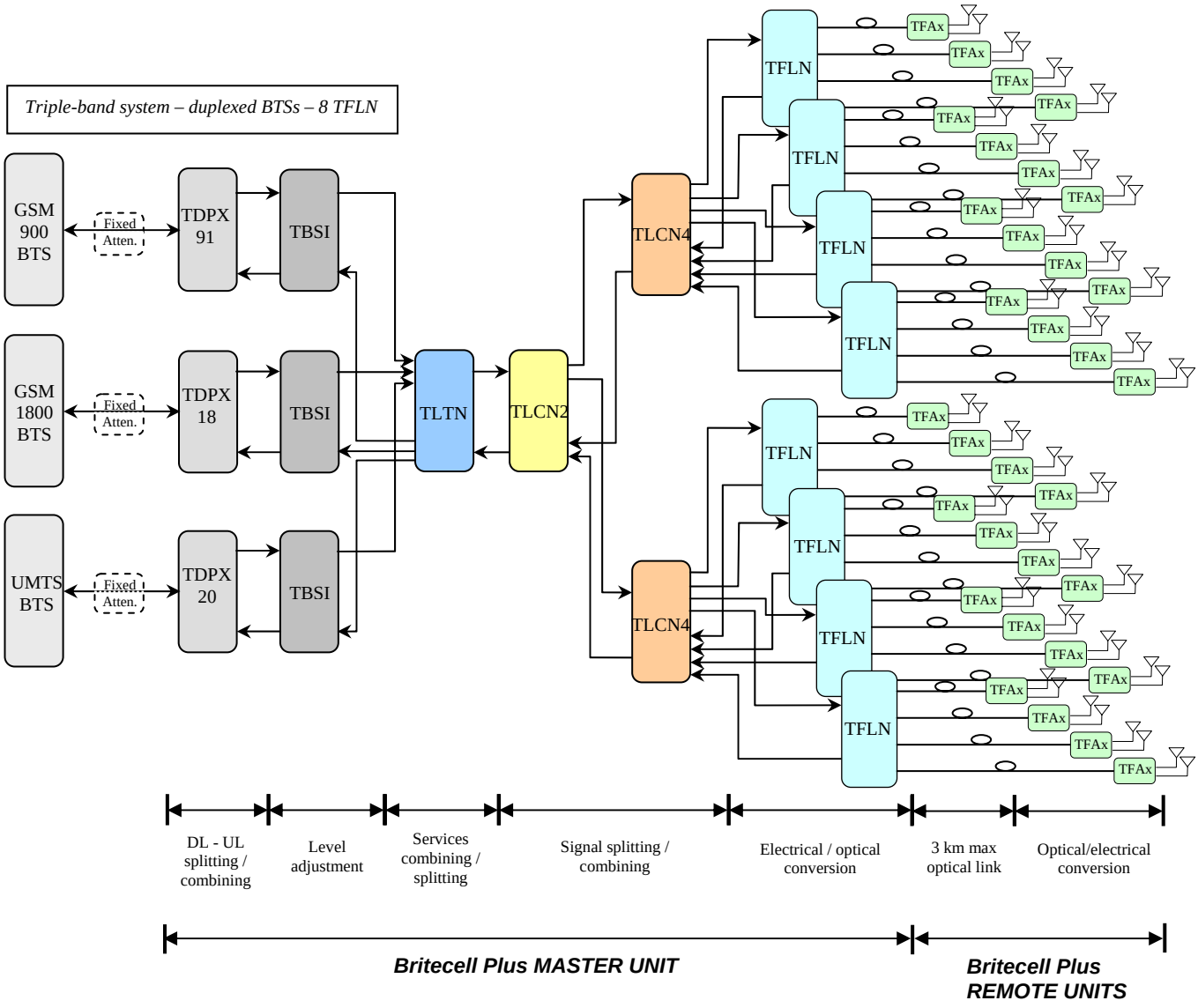


Fig. 2.19: Block diagram for a triple-band system with duplexed base stations. This scheme involves a rack-based Master Unit, with 8-TFLN optical TRXs and 32 TFAx remote units.

Let's assume we need to expand our network in a wider area, by using a second subrack station at a distance of up to 20 km from the site where the main subrack station is located.
This new network configuration requires to use an interconnect link, whose *master side* will be at the main subrack station, and whose *slave side* will be at the new remotised station.
The scheme of this new network topology is shown hereafter, in figure2.20.

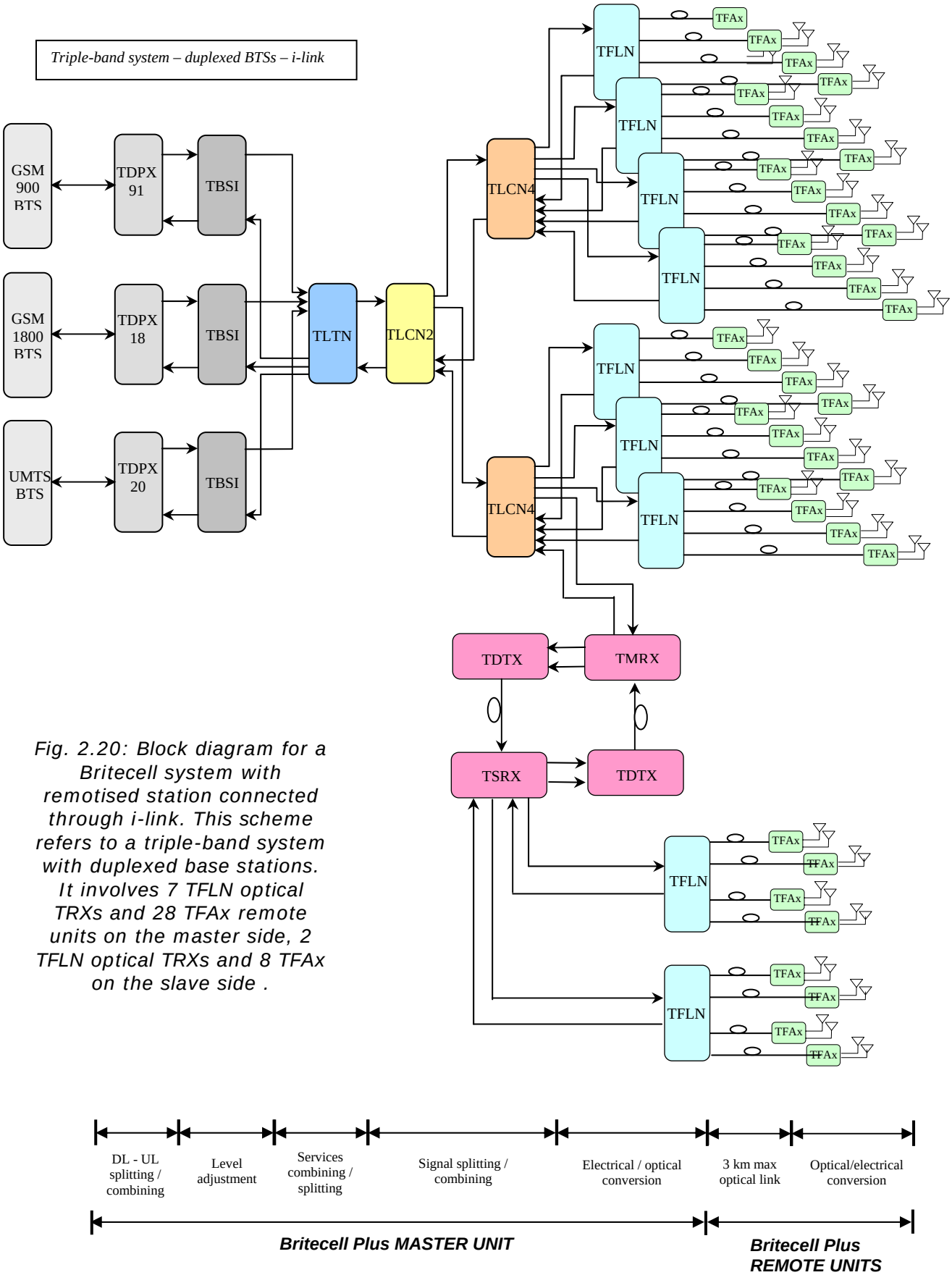


Fig. 2.20: Block diagram for a Britecell system with remotised station connected through i-link. This scheme refers to a triple-band system with duplexed base stations. It involves 7 TFLN optical TRXs and 28 TFAx remote units on the master side, 2 TFLN optical TRXs and 8 TFAx on the slave side .

Lastly, the next tables show a brief overview of the available Britecell equipment:

REMOTE UNITS and accessories		
Unit name / Module name	**Description**	**Dimensions (L x W x H)**
TFAx case A	*Remote unit*	240 x 200 x 38 (mm)
TFAx case B	*Remote unit*	240 x 240 x 38 (mm)
TFAx case L	*Remote unit*	455 x 255 x 167 (mm)
TFAx case F	*Remote unit*	546 x 253 x 207 (mm)
TFBWx	*WLAN booster*	240 x 200 x 38 (mm)
TKA01	*Remote Unit installation kit*	280 x 240 x 55 (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 3-30	*External power supply*	175 x 80 x 51 (mm)

Table 2.1(a): Overview of the Britecell Plus remote units and accessories

FAST MASTER UNIT		
Unit name / Module name	**Description**	**Dimensions (L x W x H)**
TFAF	*Fast Master Unit*	240 x 200 x 38 (cm)

Table 2.1(b): Britecell Plus fast master unit

RACK-BASED MASTER UNIT		
Unit name / Module name	**Description**	**Dimensions (L x W x H)**
TPRN04	*Passive subrack*	19” x 4HE
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
TDPXx	*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
TWLI	*WLAN interface*	14TE x 4HE
TILx-HL	*i-link kit*	14TE x 4HE (master side) + 28TE x 4HE (slave side)
TILx-HLW	*WDM i-link kit*	14TE x 4HE (master side) + 28TE x 4HE (slave side)
TSUN6	*Remote supervision unit standalone*	19” x 4HE
TSUN1 or TSUN3	*Remote supervision unit plug in*	14TE x 4HE
TRS / TRSN	*Remote supply unit*	19” x 1HE

Table 2.1(c): Overview of the Britecell Plus components and accessories for the rack-based master unit

3. TFAx Remote Unit

TFAx (intro)

Module name:

Remote Unit *TFAx*

(TFAN,TFAM,TFAH)

3.1. Introduction

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

Uplink (UL):

- RF amplification: a low noise amplifier boosts the signal received from antennas so as to maintain a good signal-to-noise ratio
- RF filtering: the boosted signal is cleaned from 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 Case-A remote units

In order to allow radio coverages with different power and band requirements, Britecell architecture provides a wide variety of remote units. This allows the customer to choose the solution which best fits its coverage and environmental demands.

Case A remote unit

Case B remote unit

Case L remote unit

Case F remote unit

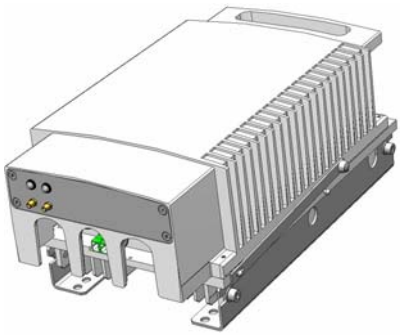


Figure 3.1: The four different case of the Britecell Plus remote unit

Depending on the bands where the radio coverage has to be provided and on the required signal power to cover the environment, your remote unit can have one of the topologies shown in figure 3.1.

The following 4 sections of the manual refers to these 4 different topologies of remote units. Please follow the instructions described in the section which exactly corresponds to the case (A,B,L,F) of your remote unit.

The output powers and coverage bands of each remote unit are uniquely associated to model codes which you can easily read on both on the remote unit and on its package box (see picture 3.2 below).

Figure 3.2

The case of your remote unit can be easily identified from the pictures 3.1: as an alternative, you can refer to the *Britecell Plus Bulletin PA-100595EN* or to the *dedicated Bulletin of your remote unit*. For example, let's refer to the Model Number "TFAM20" we read on our remote unit's label, like in the Ficture 3.2. On the *Britecell Plus bulletin PA-100595EN*, we read:

Band Configurations	Power Class	Case	Model Code	Details in Bulletin
UMTS2100	Medium	A	TFAM20	PA-100592EN

Figure 3.3

This line states that the remote unit whose model is TFAM20 has a *case A architecture (see picture 3.1)*, manages UMTS (2100 MHz) signals, and works with Medium output powers. Once we identified the case of our remote unit (*case A,* in this example), let's refer to this manual's section which exactly corresponds to our remote unit case, so as to perform proper installation and maintenance procedures.

Each Britecell Plus remote unit belongs to one of the following 3 power classes: Low, Medium and High Power. Once we know the *Power Class* of our remote unit (Medium, in our example), and its working bands (e.g. 2100 MHz UMTS), we can look through the *remote unit dedicated bulletin* (described under the column *"Details in bulletin"*: *PA-100592EN*, in our example) in order to get all the technical specifications concerning the remote unit itself.

3.2. 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 *Britecell Plus bulletin PA-100595EN* or to the *remote unit dedicated bulletin* in order to know the updated data about the weight of your case A remote unit

An external power supply is provided only for Case A remote unit TFAM20.

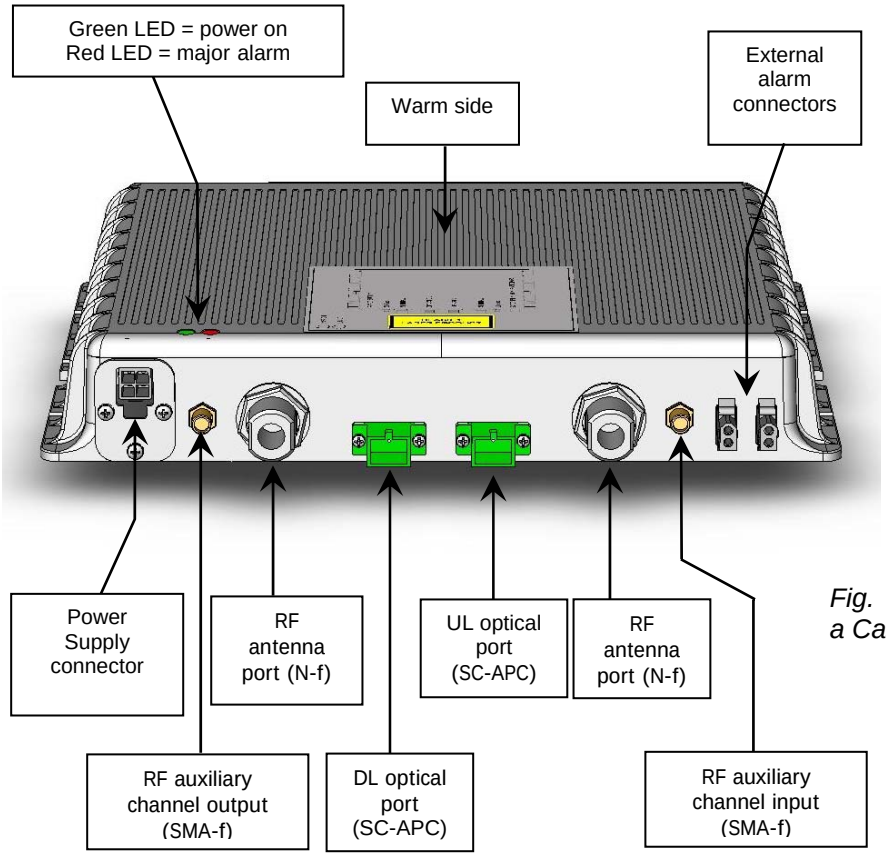


Fig. 3.4: 3D-drawing of a Case A remote unit

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 (see fog. 3.19). The green LED describes the power supply status, while the red LED describes the major Remote Unit failures (please refer to the table 3.1).

TFAx CaseA

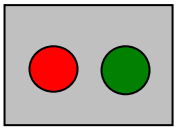


Fig. 3.5 : LED panel on the Case-A warm side

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

Table 3.1: summary of TFAx LEDs meaning

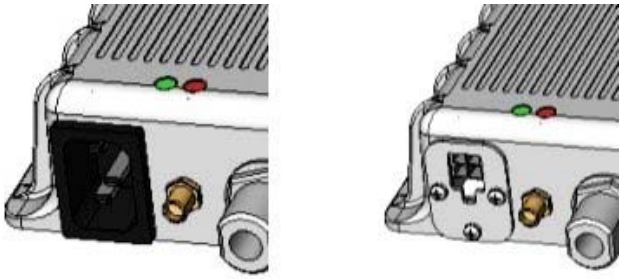
External alarms:

TFAx is provided with two dry contacts inputs, which can be connected (through .062" MOLEX plugs) to any external device. In such a way, the alarm information about this external device can be signalled through the red LED of TFAx LED panel and displayed into the supervision system.

Fig. 3.6 : Dry-contacts on Case A back side

Power supply

Case A remote units can be powered by universal mains (90 to 264 Vac) or by negative supply (-72 to -36 Vdc). Power supply is internal for all Case A remote units, except for TFAM20 which has an external adapter.
Fig. 3.9a,b shows the different power supply connectors which are provided on 90/264 Vac and on -72/-36 Vdc versions (except TFAM20).
TFAM20 remote unit is provided with the TPSN external power supply (fig. 3.8 a,b), available either for universal mains (90 to 264) or for negative supply. (-72 to -36 Vdc). They both provide the remote units with a +5Vdc power, by means of a 3-pole connector (fig. 3.10c).



(a) (b)

Fig. 3.7 : (a) IEC connector on the rear side of a 220V_{ac}-powered case A remote unit. (b) 4-pole connector on the rear side of a -48 V_{dc} -powered case A remote unit. These connectors are not available on TFAM20, which is provided with an external adapter (see below).

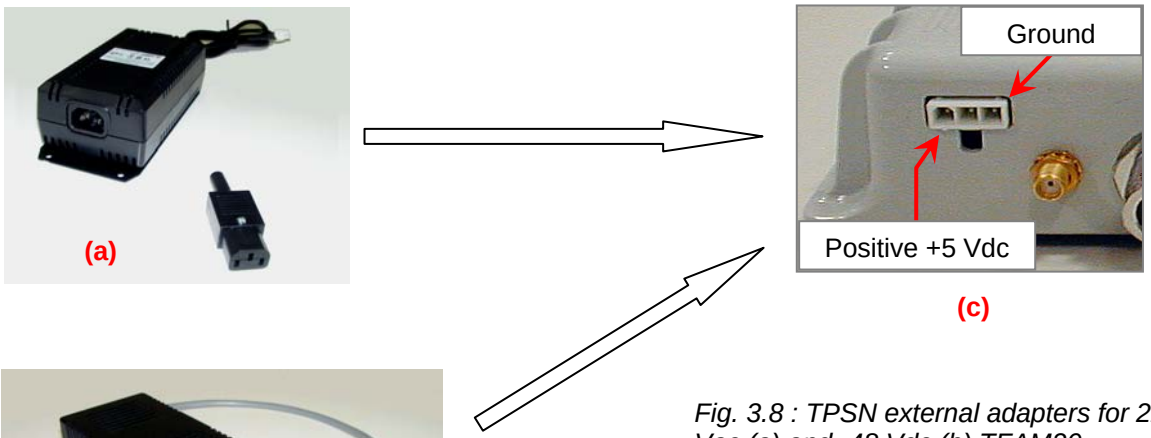


Fig. 3.8 : TPSN external adapters for 220 Vac (a) and -48 Vdc (b) TFAM20 versions. Power supply connector on the rear side of TFAM20 remote unit (c).

Warnings (to be read before the 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 figure.

- When positioning the TFAx 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 TFAx remote unit is intended to be fixed on walls, false ceilings or other flat vertical surfaces (TKA installation kits are available, in order to provide a protective cover for TFAx remote unit, while making the TFAx installation easier and faster).

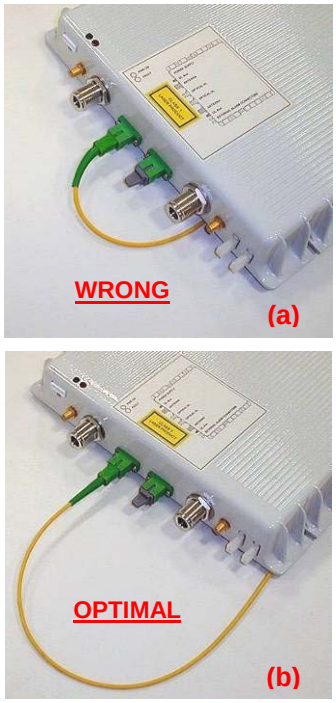


Fig. 3.9: Improper (a) and optimal (b) radius bending for a fiber optics cable.

TFAx CaseA

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, Britecell Plus 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 A installation

Versions with internal power supply
(all Case A remote units, except TFAM20)

Case A remote units can be fixed on walls, false ceilings or other flat vertical surfaces, either directly or through a TKA01 installation kit (optional).

Installing a Case A remote unit (except TFAM20) WITHOUT the TKA kit

The TFAx kit includes:

A. 1 remote unit TFAx
B. a 50 Ω load
C. a VDE connector or a -48 Vdc plug (according to the chosen model)

Remote units are provided with cooling fins which allow to optimize heat dissipation. In order to let them work, the environment where the remote unit is mounted should allow the necessary air changeover. Do not place any remote unit face downwards on a horizontal surface, because this would prevent heat dissipation.
Once you have chosen the position of the remote unit, please follow these steps in order to carry out the installation:

1. Drill into the wall so as to install the M4 screw anchors (not included) according to the case A or case B layouts indicated by the installation drawings in fig.3.15 (a)
2. Fix the TFAx remote unit to the wall by firmly screwing the anchors.
3. Take the splice – tray (not included). Fix the splice holder inside the splice tray. (see fig. 3.10a,b)
4. Splice the optical fibres and close the splice tray. While handling the fibers, take care of the fiber bending.
5. Fix the splice tray beside the remote unit
6. If the remote unit is -48 Vdc powered, use the -48 Vdc plug (included) in order to connect the unit to the -48 Vdc mains. If the remote unit is 85/264 Vac-powered, fix the 85/264 Vac plug (included) on to a power cord (not included), and use this cable in order to connect the unit to the mains.
7. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors (please refer to fig. 3.4). Apply a 50-Ohm load to the RF which are no connected to any antenna cable.
8. Once the installation is finished, please follow the section "Start-up for case A and case B remote units", in order to carry out a proper system start up.

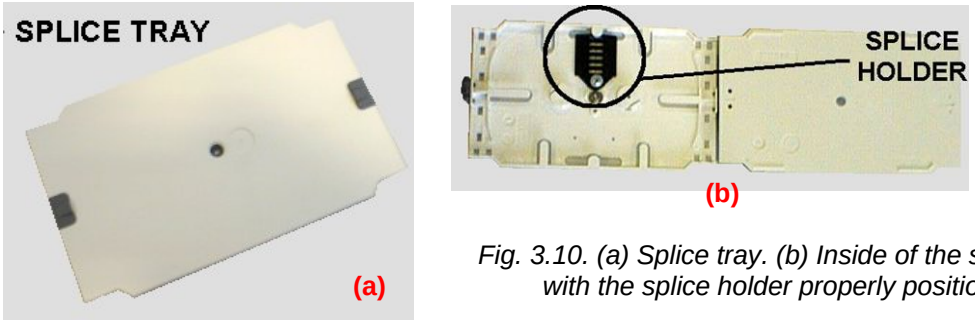


Fig. 3.10. (a) Splice tray. (b) Inside of the splice tray, with the splice holder properly positioned.

Installing the Case A remote unit (except TFAM20) WITH the TKA01 installation kit

The TFAx kit includes:

1. a remote unit TFAx
2. a 50 Ω load
3. a VDE connector or a -48 Vdc plug (according to the chosen model)

The TKA01 kit includes: (please refer to fig. 3.11)

A. 4 screw anchors (fixing the wall bearing to the wall)
B. 5 screw anchors (fixing the TFAx case A to the wall mounting box "C")
C. A wall mounting boc
D. a splice holder

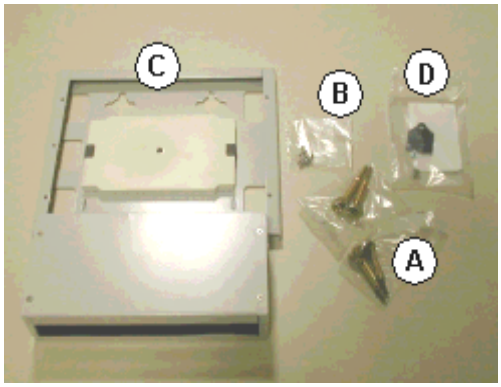


Fig. 3.11: The TKA01 installation kit

TFAx CaseA

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 TKA01 wall bearing (see fig. 3.12a)
2. In order to install the M4 screw anchors (included) which shall hold up the TKA01 wall bearing, drill into the wall according to the TKA layout shown in fig. 3.15c.
3. Fix the TKA01 wall bearing by firmly screwing the anchors.
4. Carefully open the splice tray by using a screwdriver as in fig. 3.12b. Fix the splice holder inside the splice tray. (see fig. 3.12c). Splice the optical fibres and close the splice tray. While handling the fibers, take care of the fiber bending. Close the splice tray.
5. Fix the remote unit to the wall bearing by using the included screws 3.12d.
6. If the remote unit is -48 Vdc powered, use the -48 Vdc plug (included) in order to connect the unit to the -48 Vdc mains. If the remote unit is 85/264 Vac-powered, fix the 85/264 Vac plug (included) on to a power cord (not included), and use this cable in order to connect the unit to the mains.
7. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors (fig.3.12e). If the power cable has properly been connected to the main, 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 as soon as the local unit will be switched on (for further details about the start up of the system, please refer to the section "TFAx Start-up")
8. Fix the lower cover by fastening the 4 screws (fig.3.12f).

TFAM20 installation

TFAM20 remote unit can be fixed on walls, false ceilings or other flat vertical surfaces, either directly or through a TKA01 installation kit (optional).

Installing a TFAM20 remote unit WITHOUT the TKA kit

The TFAM20 kit includes:

1. a remote unit TFAM20
2. a 50 Ω load
3. a TPSN external power supply adapter (90 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)

TFAx CaseA

Please consider carefully these guidelines in order to choose a proper positioning of the remote unit and of its power supply:

- Each piece of equipment should not be affected by the heating of 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. 3.13 a,b)
- Remote units are provided with cooling fins which allow to optimize heat dissipation. In order to let them work, the environment where the TFAM20 is mounted should allow 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 a proper heat dissipation, the external power supplies must be mounted *in vertical position with the power socket downwards* (see fig. 3.13a,b).

Once you have chosen the position of the remote unit, please follow these instructions:

1. In order to install the M4 screw anchors (not included) which shall hold up the TFAM20 remote unit, drill into the wall according to the case A layout shown in fig. 3.15a.
2. Fix the TFAM20 to the wall by firmly screwing the anchors.
3. In order to install the M4 screw anchors (not included) which shall hold up the power supply external adapter, drill into the wall according to the power supply layout shown in fig.3.15b.
4. Fix the external power supply adapter to the wall by firmly screwing the anchors.
5. Take the splice – tray (not included). Fix the splice holder inside the splice tray. (see fig. 3.10a,b)
6. Splice the optical fibres and close the splice tray. While handling the fibers, take care of the fiber bending.
7. Fix the splice tray beside the remote unit
8. Connect the external adapter to the TFAM20 remote unit through the
9. proper cable.
10. 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. 3.12b). If the remote unit is 90/264 Vac-powered, fix the 90/264 Vac plug

(included) on to a power cord (not included), and use this cable in order to the external adapter to the mains (fig. 3.12a).

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

TFAx CaseA

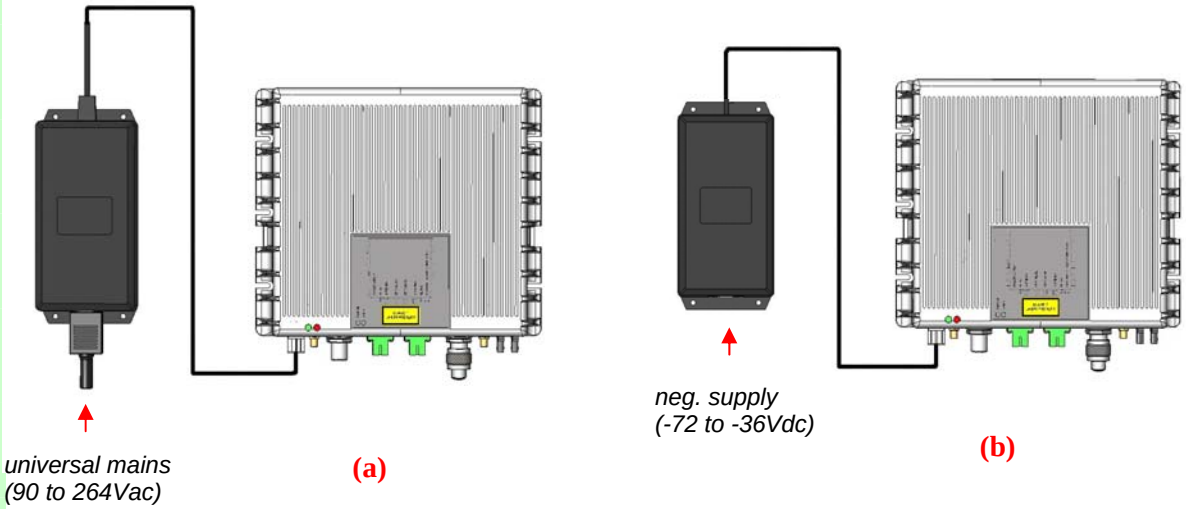


Fig. 3.12. Example of proper mounting configuration, which assures heat dissipation. Note that the remote unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The pictures refer to a 90/264 Vac – powered TFAM20 (a) and to a –72/-36 Vdc –powered TFAM20 (b).

Installation of the TFAM20 remote unit WITH the TKA01 installation kit

The TFAM20 kit includes:

1. a remote unit TFAx
2. a 50 Ω load
3. an 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 TKA01 kit includes: (please refer to fig. 3.11)

A. 4 screw anchors (fixing the wall bearing to the wall)
B. 5 screw anchors (fixing the TFAx case A to the wall mounting box "C")
C. A wall mounting boc
D. a splice holder

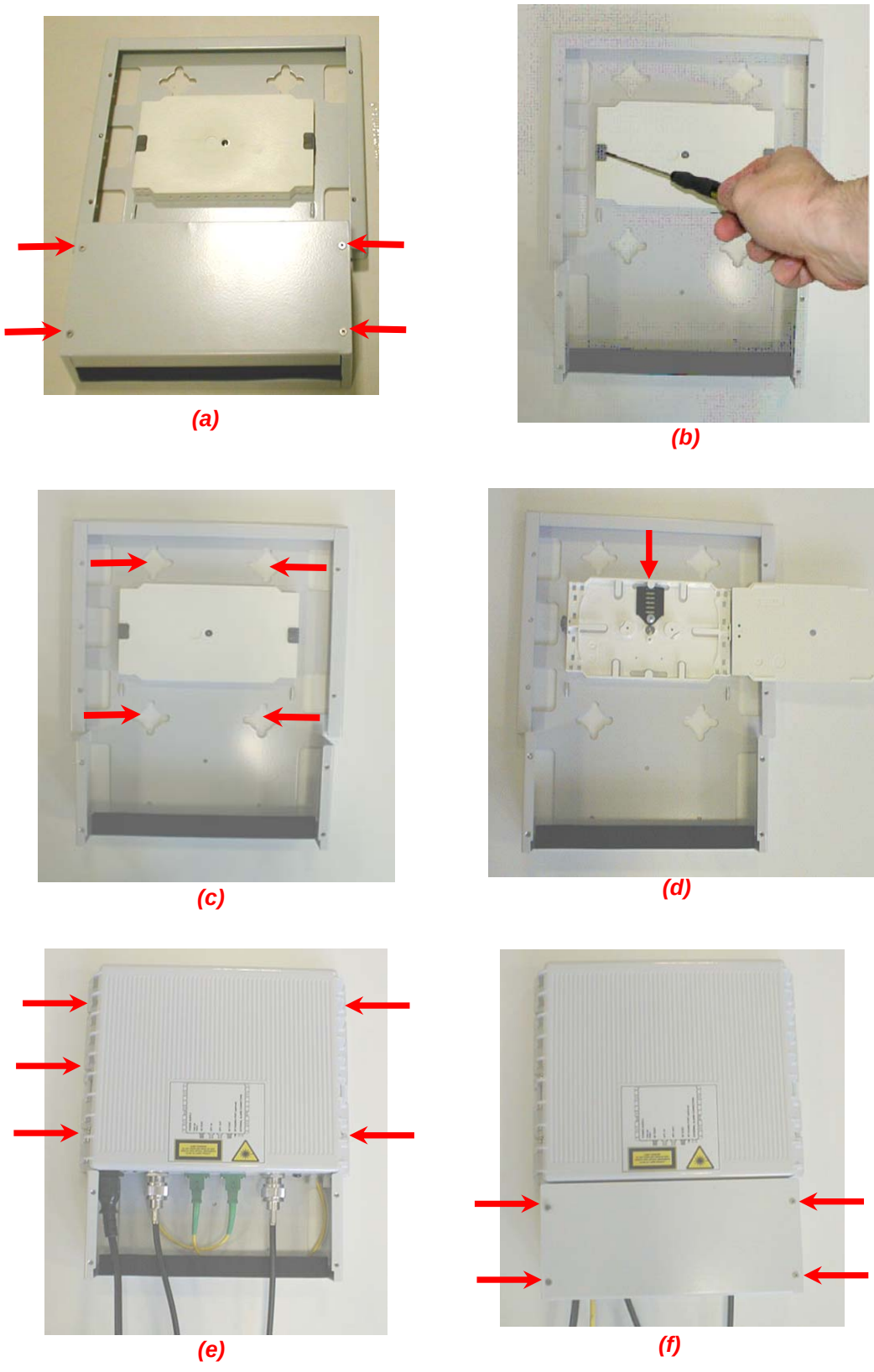


Fig. 3.13: Mounting the TFAx Case A with a TKA01 installation kit

Please consider carefully these guidelines in order to choose a proper positioning of the remote unit and of its power supply:

- Each piece of equipment should not be affected by the heating of 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. 3.14 a,b)
- 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 a proper heat dissipation, the external power supplies must be mounted *in vertical position with the power socket downwards* (see fig. 3.14a,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 TKA01 wall bearing (see fig. 3.13a)
2. In order to install the M4 screw anchors (included) which shall hold up the TKA01 wall bearing, drill into the wall according to the TKA layout shown in fig. 3.15c.
3. Fix the TKA01 wall bearing by firmly screwing the anchors.
4. In order to install the M4 screw anchors (not included) which shall hold up the power supply external adapter, drill into the wall according to the power supply layout shown in fig.3.15b
5. Fix the external power supply adapter to the wall by firmly screwing the anchors.
6. Carefully open the splice tray by using a screwdriver as in fig. 3.13b. Fix the splice holder inside the splice tray. (see fig. 3.13c). Splice the optical fibres and close the splice tray. While handling the fibers, take care of the fiber bending. Close the splice tray.
7. Fix the remote unit to the wall bearing by using the included screws 3.13d.
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. 3.14a). If the remote unit is 90/264 Vac-powered, fix the 90/264 Vac plug (included) on to a power cord (not included), and use this cable in order to connect the external adapter to the mains (fig. 3.14b).
9. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors (fig.3.13e). If the power cable has properly been connected to the main, 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 as soon as the local unit will be 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.3.13f).

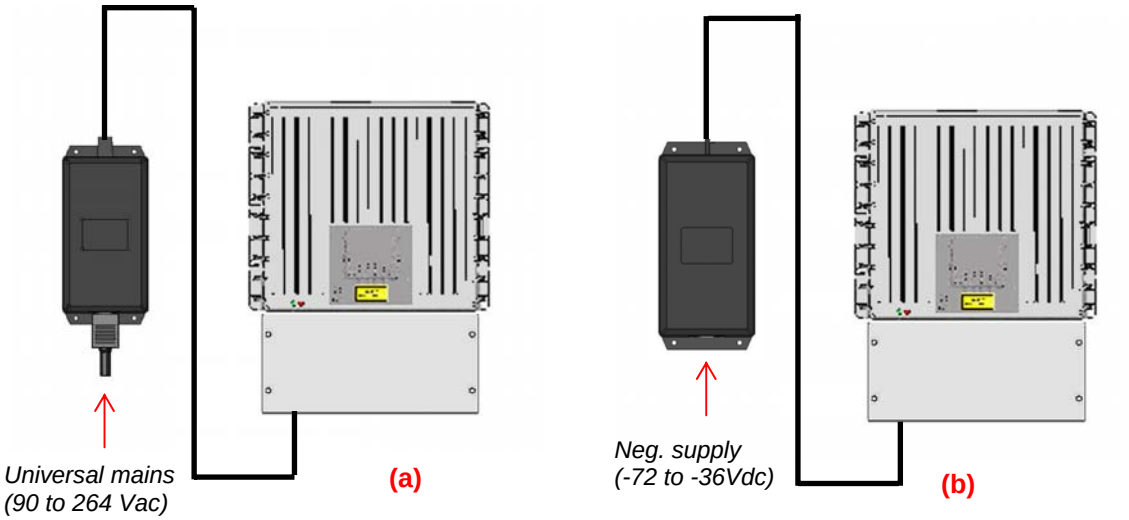


Fig. 3.14. Example of proper mounting configuration, which assures proper heat dissipation. Note that the remote unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The pictures refer to a 90/264 Vac –powered TFAM20 (a) and to a -72/-36 Vdc –powered TFAM20 (b).

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

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 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 have to be the one reported in table 3.1. In case the red LED remains on, please refer to the troubleshooting section.
4. After being 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 which can last at max. 4min, depending on the system complexity, the TFLN LED ┌┘ blinks.

Do not connect/disconnect any cable or any piece of equipment during the discovery phase! This may result in failing the identification of the remote unit.

Note: in case 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).

Case A TFAx troubleshooting

TFAx CaseA

Faults can be revealed by LEDs on the TFAx 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 failure detection is directly carried out through LMT or supervision system.

Britecell Plus modules are designed in order to exchange information, so 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 3.2 and 3.3 show a brief description of the alarms related to a Case A remote unit, with a reference to the corresponding alerted LEDs and to the actions to be carried out in the case of a fault.

TFAN					
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	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	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	WARNING	Clean optical connectors	MINOR
DL RF low band alarm	HW failure on the DL low band RF section	RED	CRITICAL	Return the unit	MAJOR
DL RF high band alarm	HW failure on the DL high 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

Table 3.2. Description of the alarms of the TFAN Case A Remote Unit, as they are presented on LMT or Supervision Interface

As the tables show, minor alarms (low priority alarms) are revealed only by LMT or supervision system, but not by 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 can correctly compensate optical losses when these are estimated to be <3 dB. In case optical losses are in the 3dB-4dB range, the whole system still works, but AGC is near to its borderline levels. The red LED switches on when the estimated optical losses are >4dB, 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.

[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 dB. In case optical losses are in the 3dB- 4dB range, the AGC is said to be "out of range": the whole system still work, but AGC is near to its borderline levels. The DL power LED switches on when the estimated optical losses are >4dB, 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.

TFAM20					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Antenna DC loop alarm	ALWAYS OK				
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	ALWAYS OK				
DL optical power fail	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	The optical power received is under the allowed 3dB optical loss but it can be compensated	NONE	WARNING	Clean optical connectors	MINOR
DL UMTS band alarm	HW failure on the DL UMTS section	RED	CRITICAL	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	RED if temperature >85°C	MINOR	Check ventilation and environment	MINOR

Table 3.3. Description of the alarms of the TFAM20 Remote Unit, as they are presented on LMT or Supervision Interface

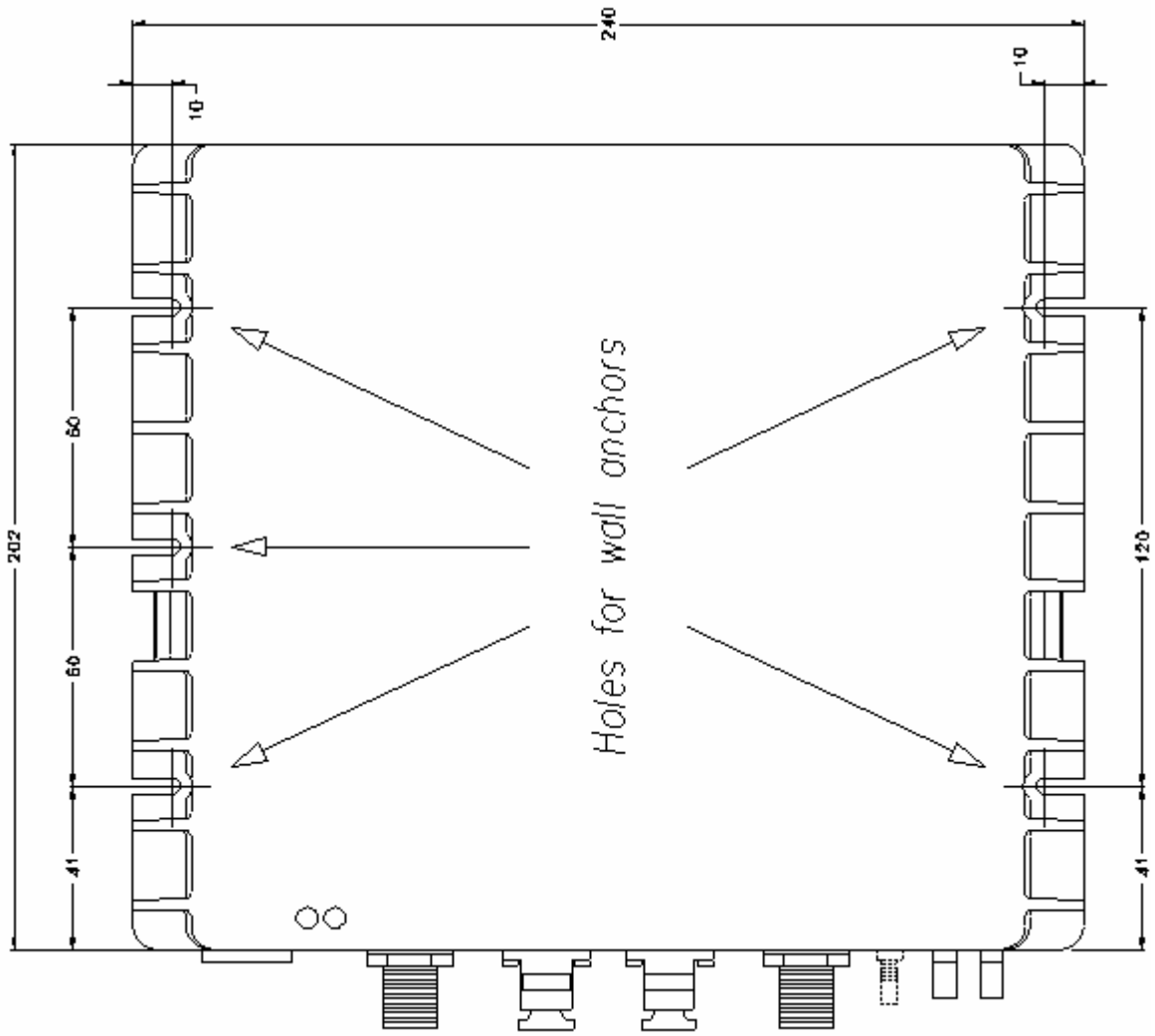


Fig. 3.15(a): CASE A layout with wall anchor quotes

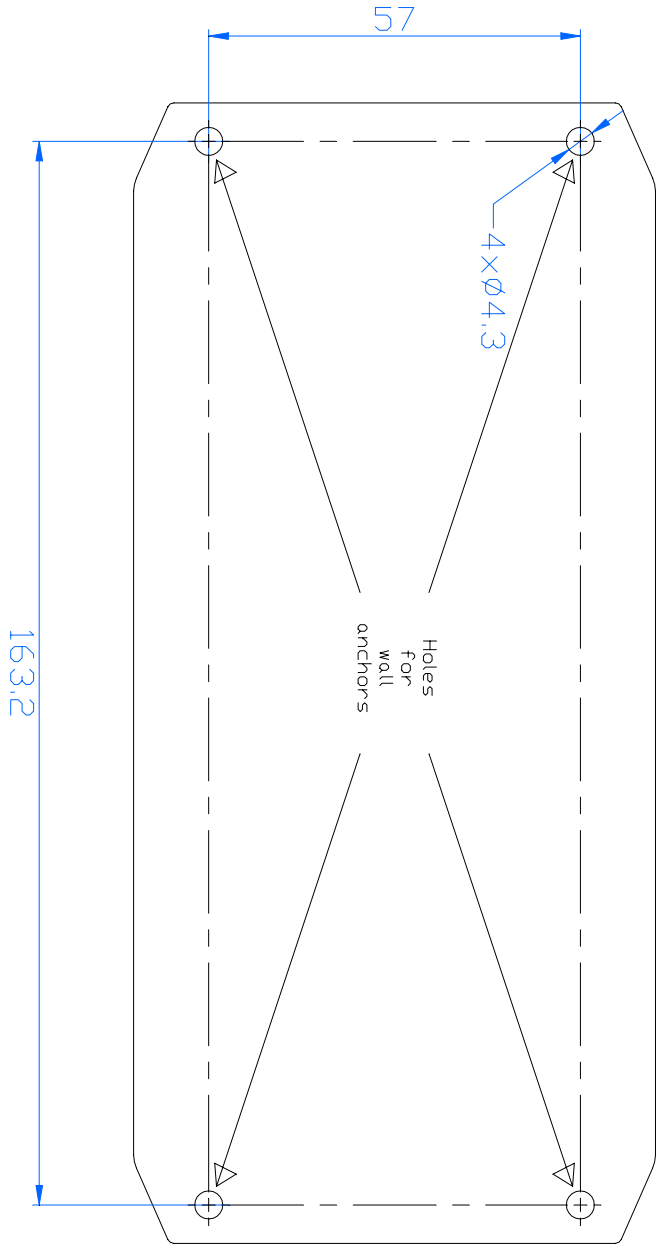


Fig. 3.15(b): External Power Supply layout with wall anchor quotes. It is highly recommended to mount it on a vertical surface in vertical position with the socket downwards.

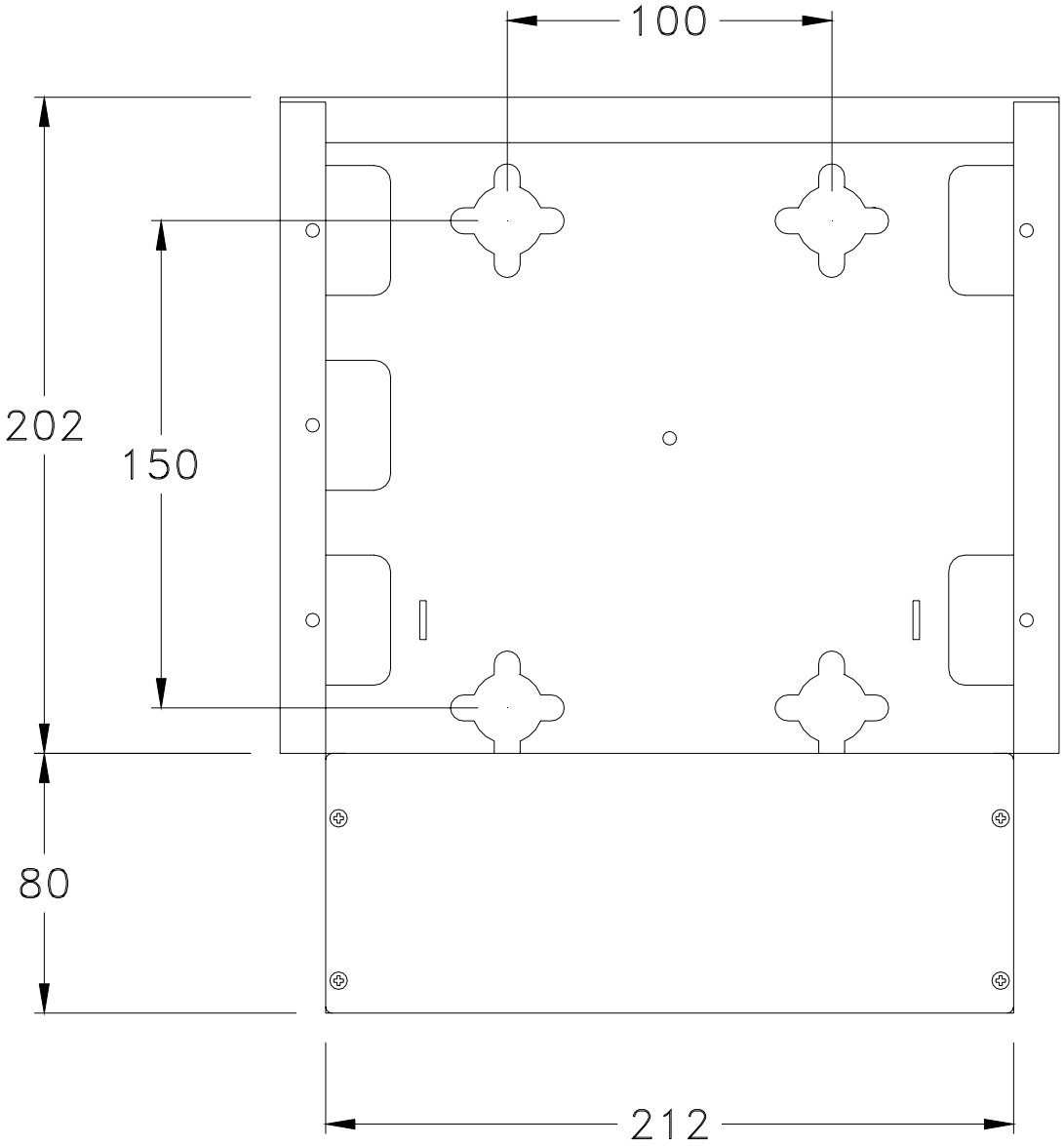


Fig. 3.15(c): TKA layout with wall anchor quotes

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 3.16a)
In case the red LED is ON, please follow these steps:

1. First of all, refer to dry-contact troubleshooting in order to understand whether the alarm can depend on any external equipment failure or not.
2. In case dry-contact troubleshooting has not revealed any failure, clean the optical adapters
3. 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.
4. 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. 3.16b)
This procedure needs to be considered if at least one TFAx dry-contact is connected to some external equipment. If not, return to main troubleshooting procedure.
These steps aim to detect any failure inside the external equipment or inside the dry-contact port. If dry-contacts don't reveal equipment malfunction or a port failure, return to the main troubleshooting procedure.
For any dry-contact connected to some 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, external equipment connected to the dry contact port should be faulty. Please test it.
3. If the TFAx red LED still remains on after the disconnection, measure 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. In case the TFAx has another unchecked dry-contact connected to some external equipment, apply the whole procedure (i.e. the steps 1-3) to this new port

Fibre optic DL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 3.16c)

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.

TFAx CaseA

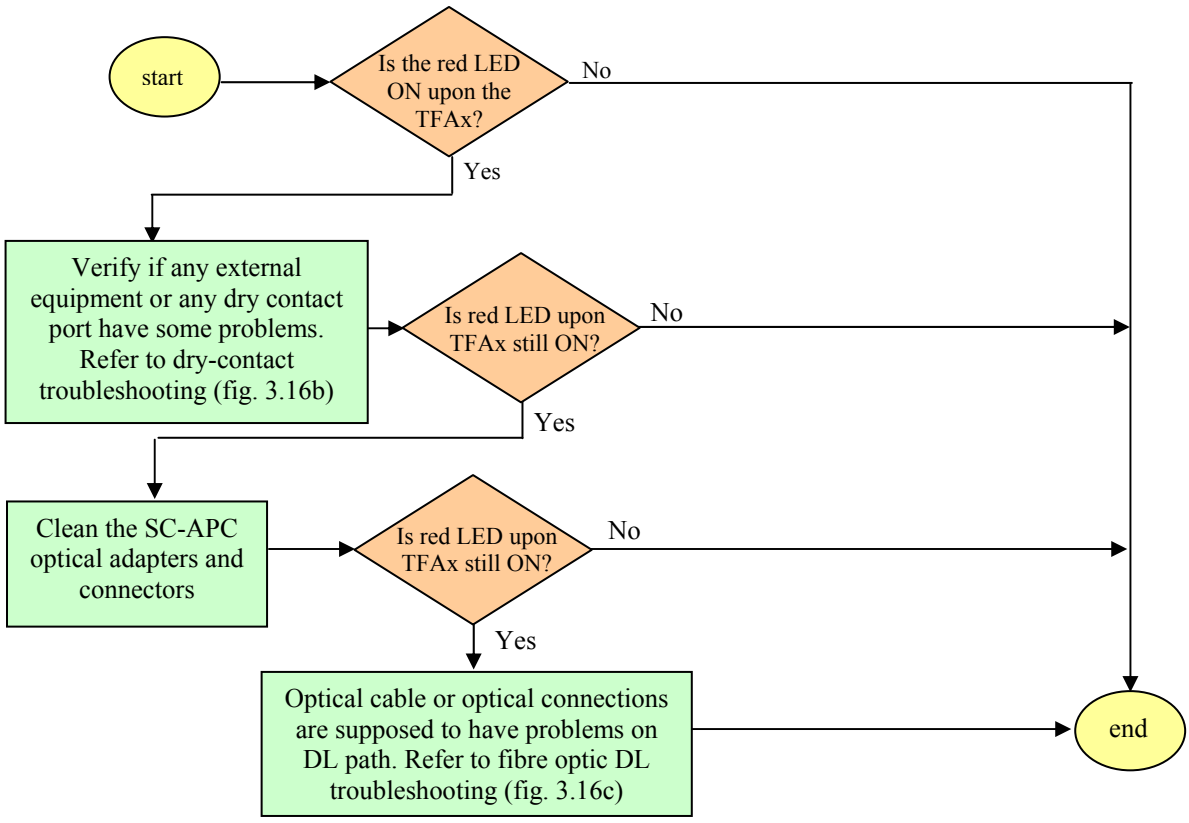


Fig. 3.16(a): Flow-chart describing the quick troubleshooting procedure on Case A TFAx

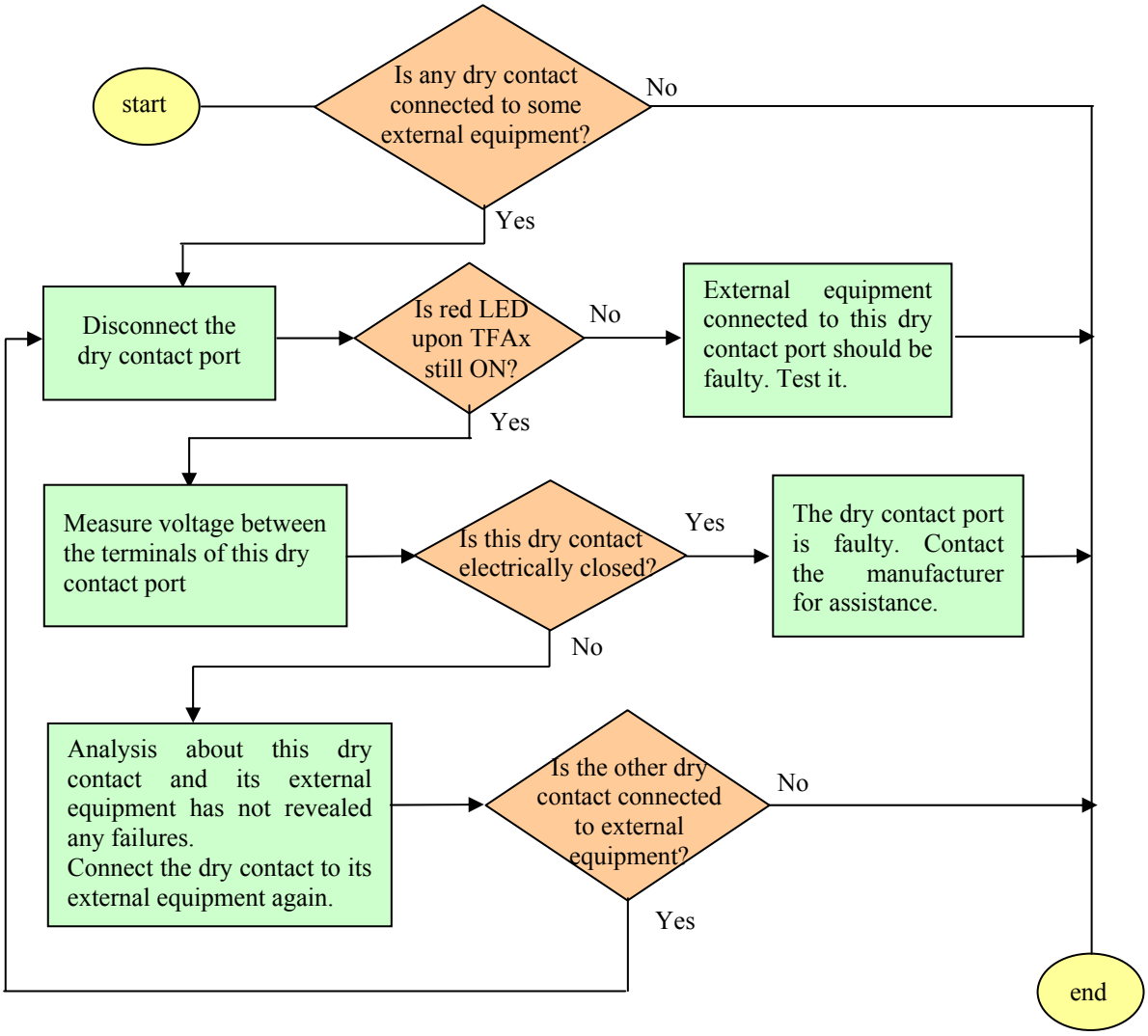


Fig. 3.16(b): Flow-chart describing the external alarm troubleshooting on Case A TFAx.

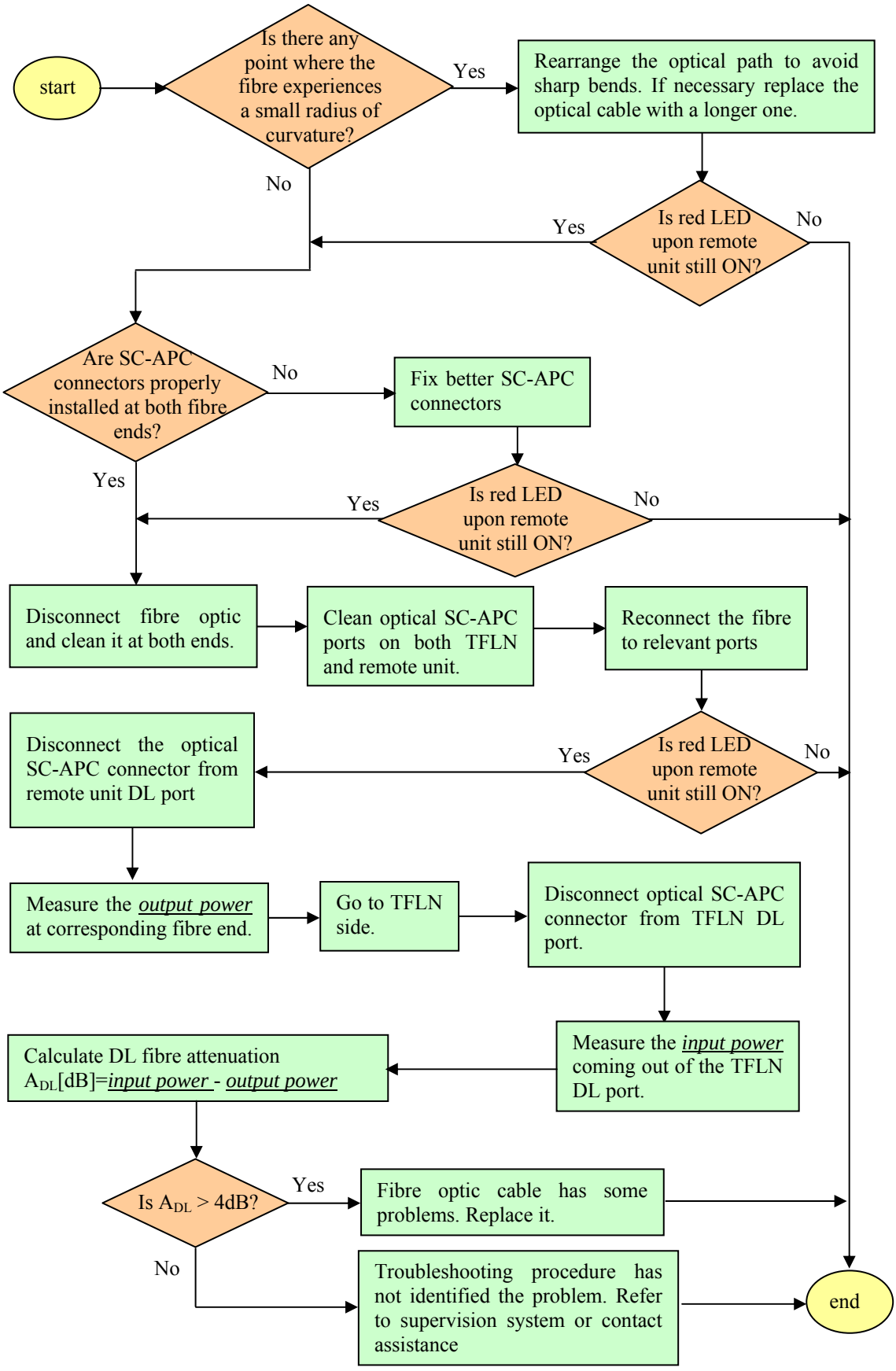


Fig. 3.16 (c): Flow-chart describing the fibre optic DL troubleshooting

3.3. 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 *Bulletin PA-100595EN* or to the *remote unit dedicated bulletin* in order to know the updated data about
the weight of your case L remote unit

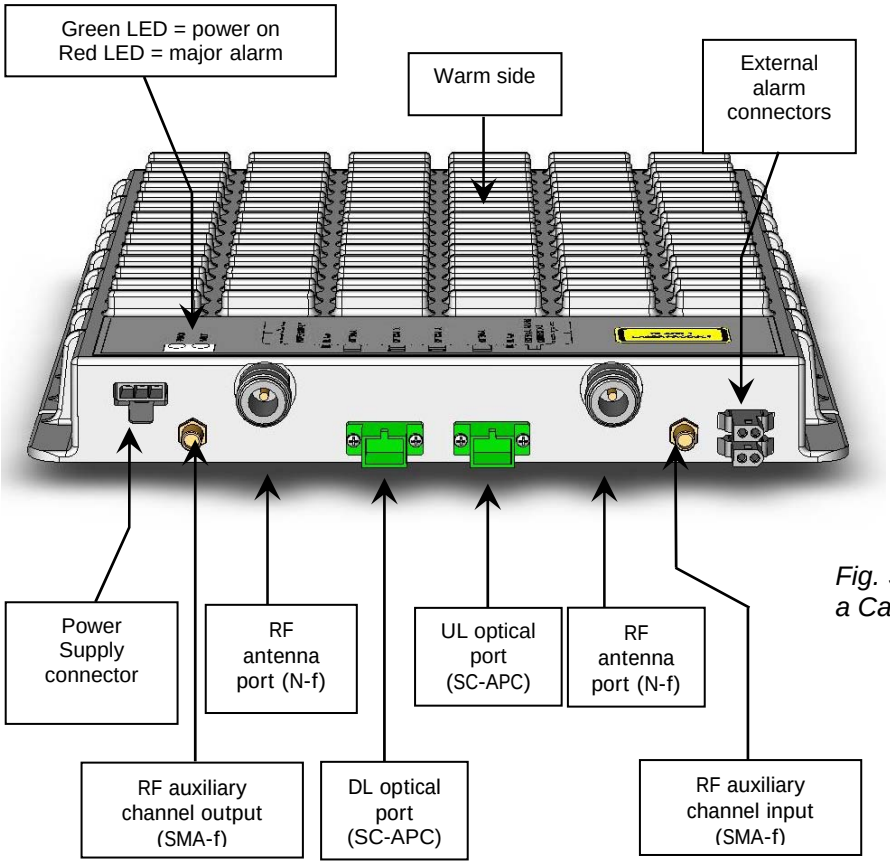


Fig. 3.17: 3D-drawing of a Case B remote unit

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.3.18). The green LED describes the power supply status, while the red LED describes the major Remote Unit failures (please refer to the table 3.4).

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

Table 3.4: summary of TFAx LEDs meaning

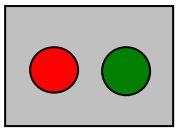


Fig. 3.18 : LED panel on the Case-B warm side

TFAx CaseB

Dry contact alarms:

TFAx is provided with two dry contacts inputs, which can be connected (through .062" MOLEX plugs) to any external device. In such a way, the alarm information about this external device can be signalled through the red LED of TFAx LED panel and displayed into the supervision system.

Fig. 3.19 : Dry-contacts on Case B back side

Power supply

The Case B remote unit is provided with an external power supply TPSN (fig. 3.20 a,b), available either for universal mains (90 to 264) or for negative supply. (-72 to -36 Vdc). Each TPSN external power supply provides the remote units with a +5Vdc power, by means of a 3-pole connector (fig. 3.20c).

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.

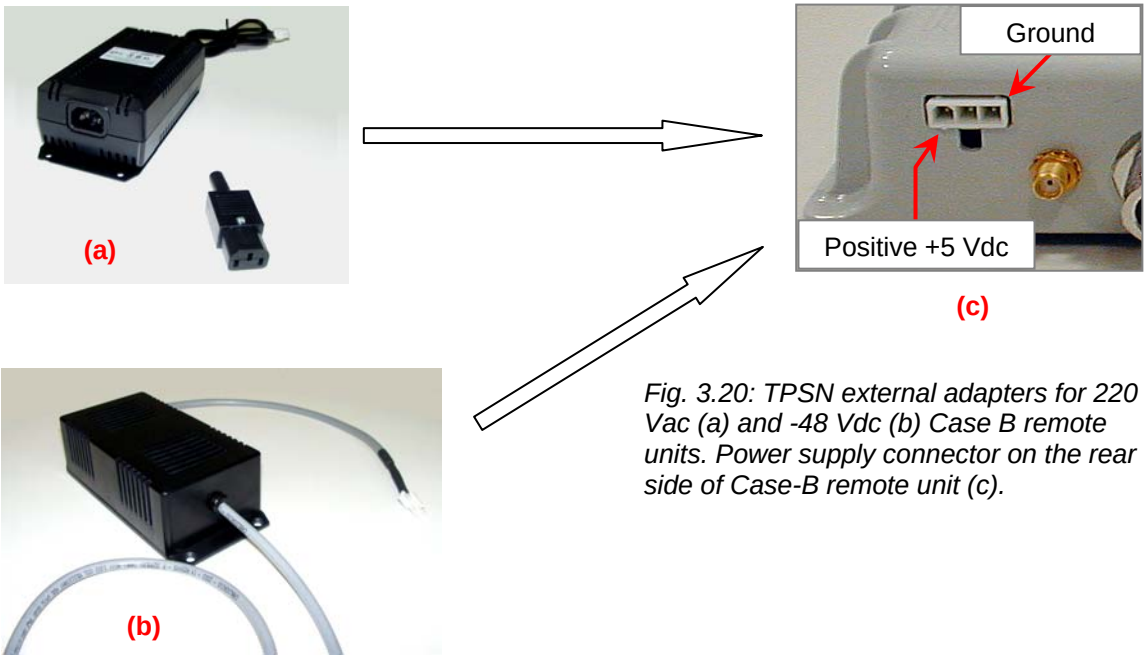


Fig. 3.20: TPSN external adapters for 220 Vac (a) and -48 Vdc (b) Case B remote units. Power supply connector on the rear side of Case-B remote unit (c).

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 figure.
- When positioning the TFAx 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 TFAx remote unit is intended to be fixed on walls, false ceilings or other flat vertical surfaces (TKA installation kits are available, in order to provide a protective cover for TFAx remote unit, while making the TFAx installation easier and faster).

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, Britecell Plus 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 B installation

CaseB remote unit can be fixed on 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:

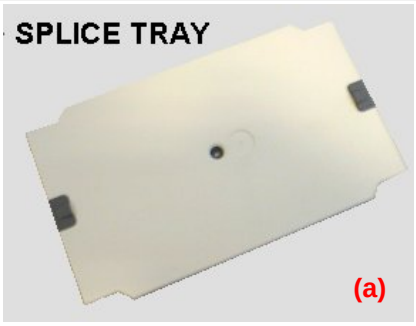
a. a remote unit TFAx
b. a 50 Ω load
c. a TPSN external power supply adapter (86 to 264 Vac or -72 to -36 Vdc, according to the chosen model)
d. a VDE connector or a -48 Vdc plug (according to the chosen model)

Please consider carefully these guidelines in order to choose a proper positioning of the remote unit and of its power supply:

- Each piece of equipment should not be affected by the heating of 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. 3.22 a,b)
- Remote units are provided with cooling fins which allow to optimize heat dissipation. In order to let them work, the environment where the TFAx is mounted should allow 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 a proper heat dissipation, the external power supplies must be mounted in vertical position with the power socket downwards (see fig. 13.22a,b).

Once you have chosen the position of the remote unit, please follow these instructions:

1. In order to install the M4 screw anchors (not included) which shall hold up the TFAx remote unit, drill into the wall according to the case B layout shown in fig. 3.24a.
2. Fix the TFAx to the wall by firmly screwing the anchors.
3. In order to install the M4 screw anchors (not included) which shall hold up the power supply external adapter, drill into the wall according to the power supply layout shown in fig.3.24b
4. Fix the external power supply adapter to the wall by firmly screwing the anchors.
5. Take the splice – tray (not included). Fix the splice holder inside the splice tray. (see fig. 3.21a,b)



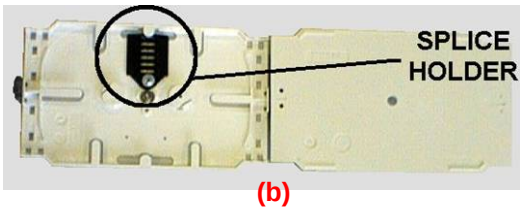


Fig. 3.21. (a) Splice tray. (b) Inside of the splice tray, with the splice holder properly positioned.

6. Splice the optical fibres and close the splice tray. While handling the fibers, take care of the fiber bending.
7. Fix the splice tray beside the remote unit
8. Connect the external adapter to the TFAx remote unit through 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. 3.22b). If the remote unit is 90/264 Vac-powered, fix the 90/264 Vac plug (included) on to a power cord (not included), and use this cable in order to connect the external adapter to the mains (fig. 3.22a).
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.

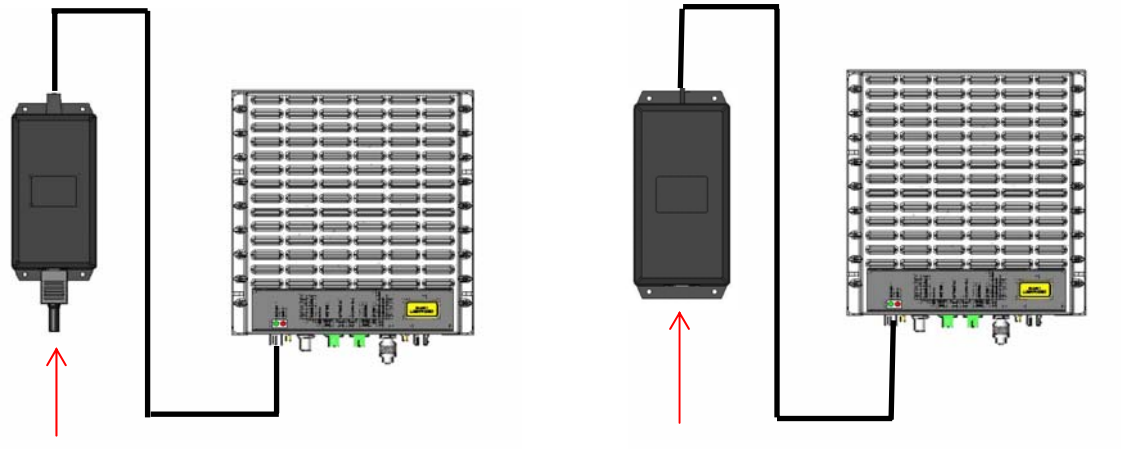


Fig. 3.22. Example of proper mounting configuration, which assures heat dissipation. Note that the remote unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The pictures refer to a 90/264 Vac – powered TFAx Case B (a) and to a -36/-72 Vdc –powered TFAx Case B (b).

Installation of the Case B remote unit WITH the TKA04 installation kit

The TFAx Case B kit includes:

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

The TKA04 kit includes:

A. 4 screw anchors (fixing the wall bearing to the wall)
B. 5 screw anchors (fixing the TFAx Case B to the wall bearing)
C. a wall mounting box (wall bearing + cover)
D. a splice holder

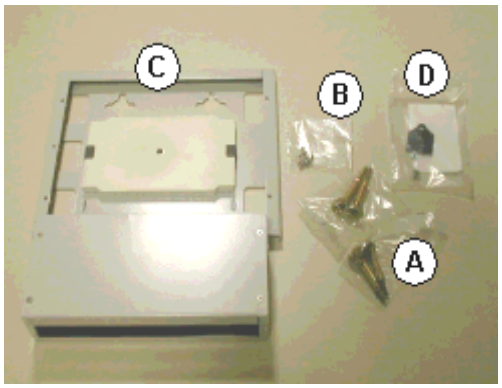


Fig. 3.23: The TKA installation kit

Please consider carefully these guidelines in order to choose a proper positioning of the remote unit and of its power supply:

- Each piece of equipment should not be affected by the heating of 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. 3.24 a,b)
- 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 a proper heat dissipation, the external power supplies must be mounted *in vertical position with the power socket downwards* (see fig. 3.24a,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. 3.26a)
2. In order to install the M4 screw anchors (included) which shall hold up the TKA04 wall bearing, drill into the wall according to the TKA layout shown in fig. 3.25c.

3. Fix the TKA04 wall bearing by firmly screwing the anchors.
4. In order to install the M4 screw anchors (not included) which shall hold up the power supply external adapter, drill into the wall according to the power supply layout shown in fig.3.25b.
5. Fix the external power supply adapter to the wall by firmly screwing the anchors.
6. Carefully open the splice tray by using a screwdriver as in fig. 3.26b. Fix the splice holder inside the splice tray (fig. 3.26c). Splice the optical fibres and close the splice tray. While handling the fibers, take care of the fiber bending. Close the splice tray.

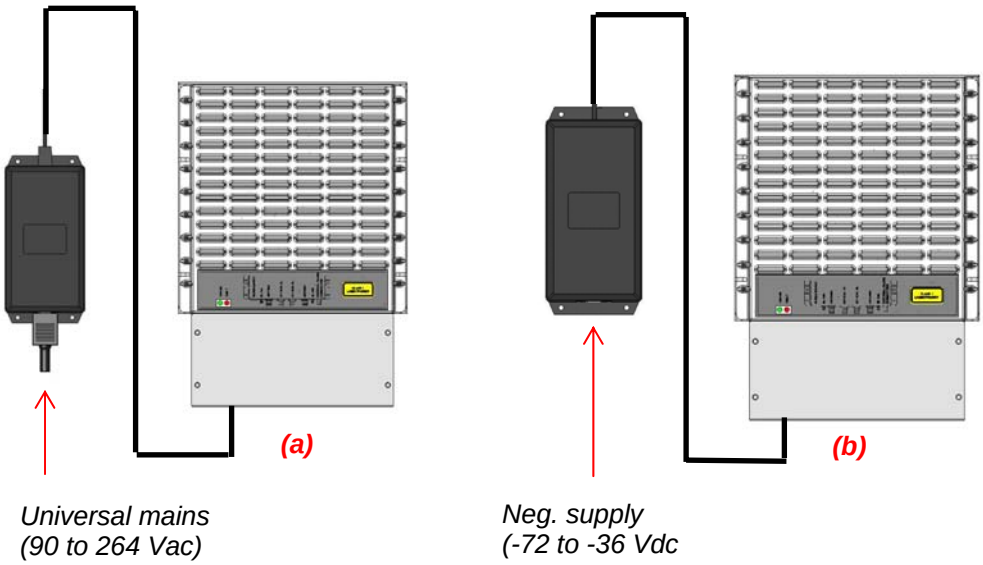


Fig. 3.24. Example of proper mounting configuration, which assures proper heat dissipation. Note that the remote unit and its power supply adapter are mounted side-by-side, and the power supply adapter has the socket downwards. The pictures refer to a 220 Vac – powered TFAx Case B (a) and to a -48 Vdc –powered TFAx Case B (b).

7. Fix the remote unit to the wall-bearing by using the included screws (fig. 3.26d).
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. 3.24b). If the remote unit is 90/264 Vac-powered, fix the 90/264 Vac plug (included) on to a power cord (not included), and use this cable in order to connect the external adapter to the mains (fig. 3.24a).
9. Connect the antenna RF cables to the RF antenna ports. Connect the UL and DL optical connectors (fig. 3.26e). If the power cable has properly been connected to the main, 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 as soon as the local unit will be 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. 3.26f)

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

1. When the remote unit is turned on, both the LEDs upon the warm side turn on for a couple of seconds

TFAx CaseB

2. After that, the unit 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 have to be the one reported in table 3.4. In case the red LED remains on, please refer to the troubleshooting section.
4. After being 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 which can last at max. 4min, depending on the system complexity, the TFLN LED ┌┘ blinks. **Do not connect/disconnect any cable or any piece of equipment during the discovery phase!** This may result in failing the identification of the remote unit.

Note: in case 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 B troubleshooting

Faults can be revealed by LEDs on the TFAx 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 failure detection is directly carried out through LMT or supervision system.
Britecell Plus modules are designed in order to exchange information, so 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.

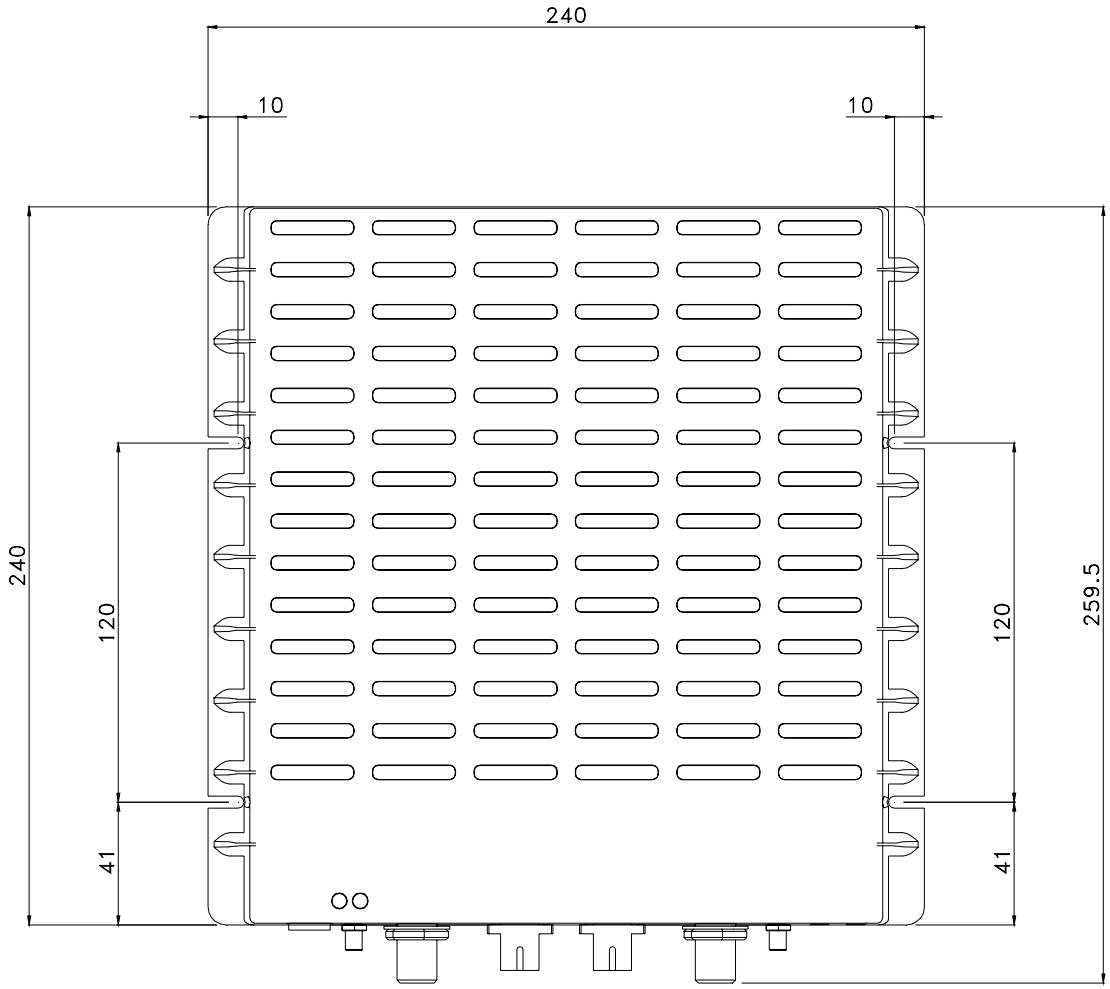


Fig. 3.25 (a): CASE B layout with wall anchor quotes

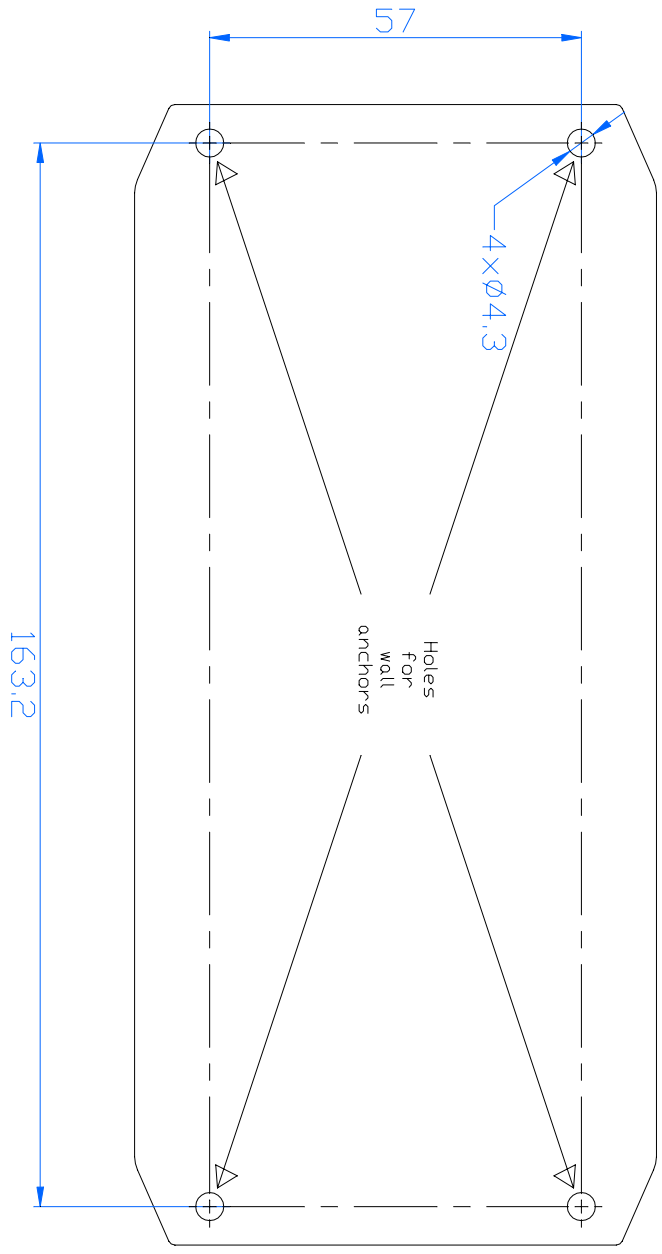


Fig. 3.25 (b): External Power Supply layout with wall anchor quotes. It is highly recommended to mount it on a vertical surface in vertical position with the socket downwards.

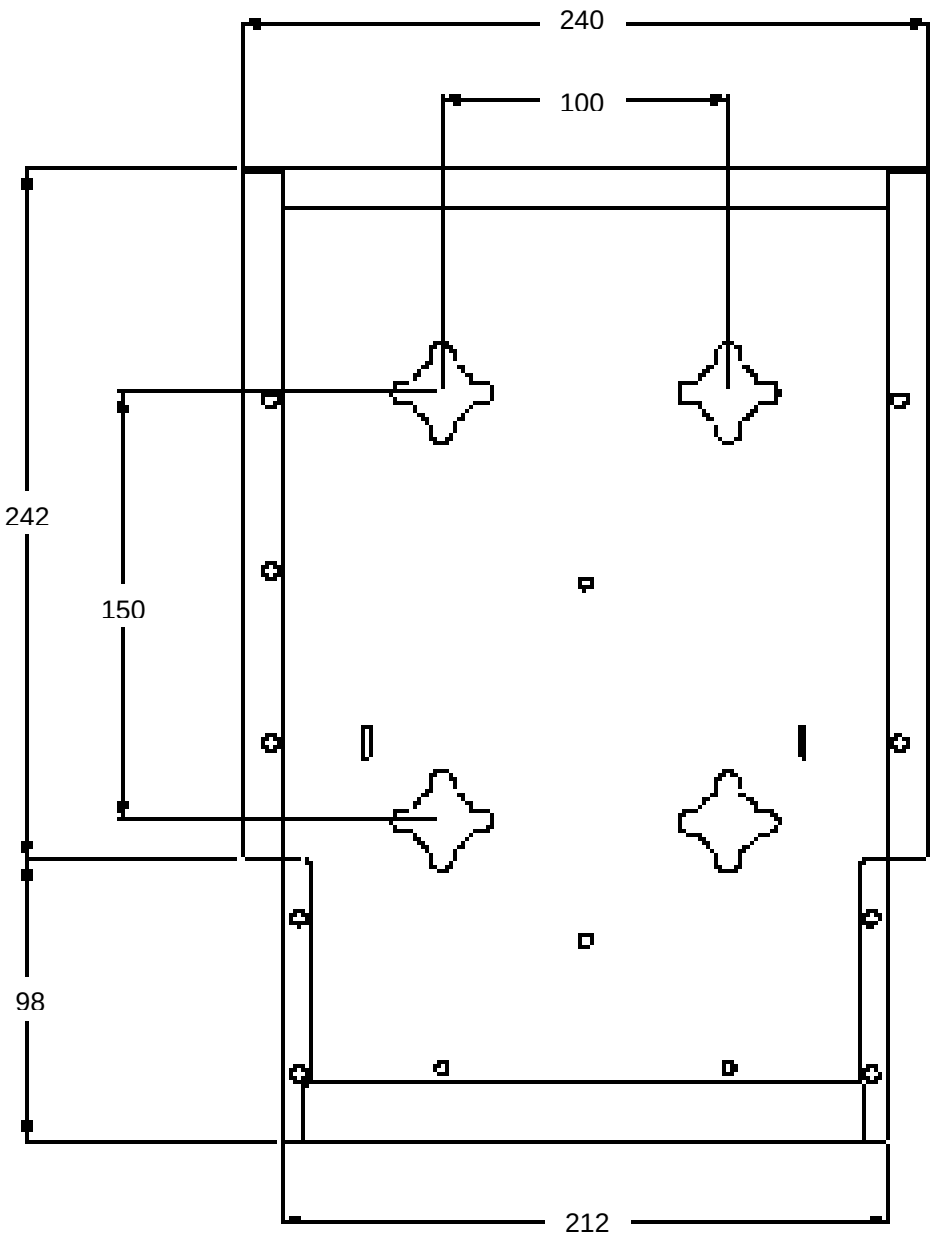


Fig. 3.25 (c): TKA layout with wall anchor quotes

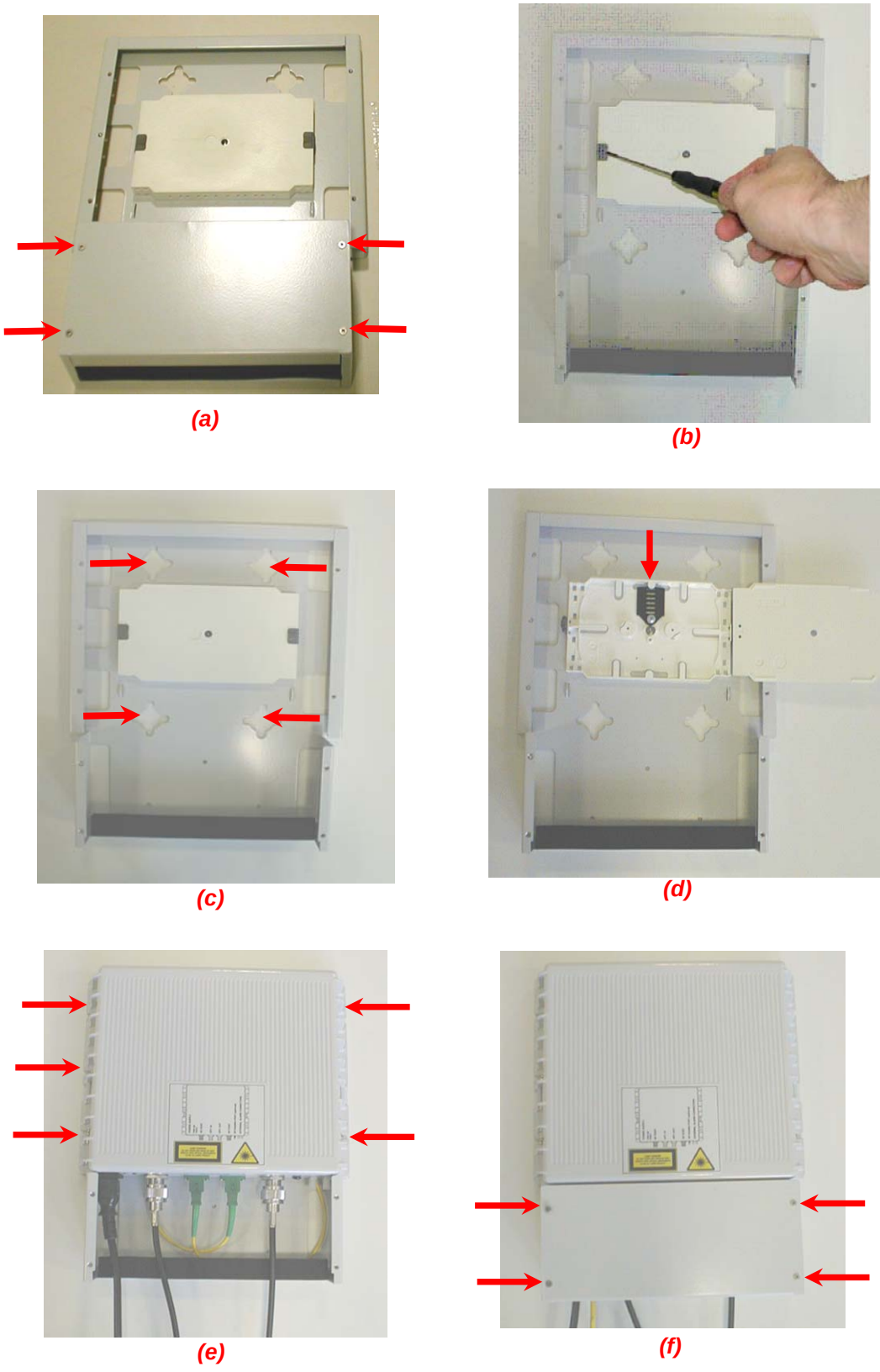


Fig. 3.26: Mounting the TFAx with a TKA installation kit. Please note that these pitctures refers to the mounting of a Case A TFAx with a TKa01 kit. However, the installation procedure is identical for mounting a TFAx case B with a TKA04 kit.

Tables 3.5 and 3.6 show a brief description of the alarms related to a Case B remote unit, with a reference to the corresponding alerted LEDs and to the actions to be carried out in the case of a fault.

TFAN (tri band)					
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 low band alarm	HW failure on the DL low band RF section	RED	CRITICAL	Return the unit	MAJOR
DL RF high band alarm	HW failure on the DL high 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
DL UMTS band alarm	HW failure on the DL UMTS band RF section	RED	CRITICAL	Return the unit	MAJOR

Table 3.5. Description of the alarms of the TFAN Case-B Remote Unit, as they are presented on LMT or Supervision Interface

TFAx CaseB

TFAM					
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 UMTS band alarm	HW failure on the DL UMTS section	RED	CRITICAL	Return the unit	MAJOR
External 1alarm	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	ALWAYS OK				

Table 3.6. Description of the alarms of the TFAM Case-B Remote Unit, as they are presented on LMT or Supervision Interface

As the tables show minor alarms (low priority alarms) are revealed only by LMT or supervision system, but not by 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 can correctly compensate optical losses when these are estimated to be <3 dB. In case optical losses are in the 3dB-4dB range, the whole system still works, but AGC is near to its borderline levels. The red LED switches on when the estimated optical losses are >4dB, 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.

[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 dB. In case optical losses are in the 3dB- 4dB range, the AGC is said to be "out of range": the whole system still work, but AGC is near to its borderline levels. The DL power LED switches on when the estimated optical losses are >4dB, 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.

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 3.27a)
In case the red LED is ON, please follow these steps:

1. First of all, refer to dry-contact troubleshooting in order to understand whether the alarm can depend on any external equipment failure or not.
2. In case dry-contact troubleshooting has not revealed any failure, clean the optical adapters
3. 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.
4. 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. 3.27b)
This procedure needs to be considered if at least one TFAx dry-contact is connected to some external equipment. If not, return to main troubleshooting procedure.
These steps aim to detect any failure inside the external equipment or inside the dry-contact port. If dry-contacts don't reveal equipment malfunction or a port failure, return to the main troubleshooting procedure.
For any dry-contact connected to some 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, external equipment connected to the dry contact port should be faulty. Please test it.
3. If the TFAx red LED still remains on after the disconnection, measure 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. In case the TFAx has another unchecked dry-contact connected to some external equipment, apply the whole procedure (ie steps 1-3) to this new port

Fibre optic DL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 3.27c)

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.

TFAx CaseB

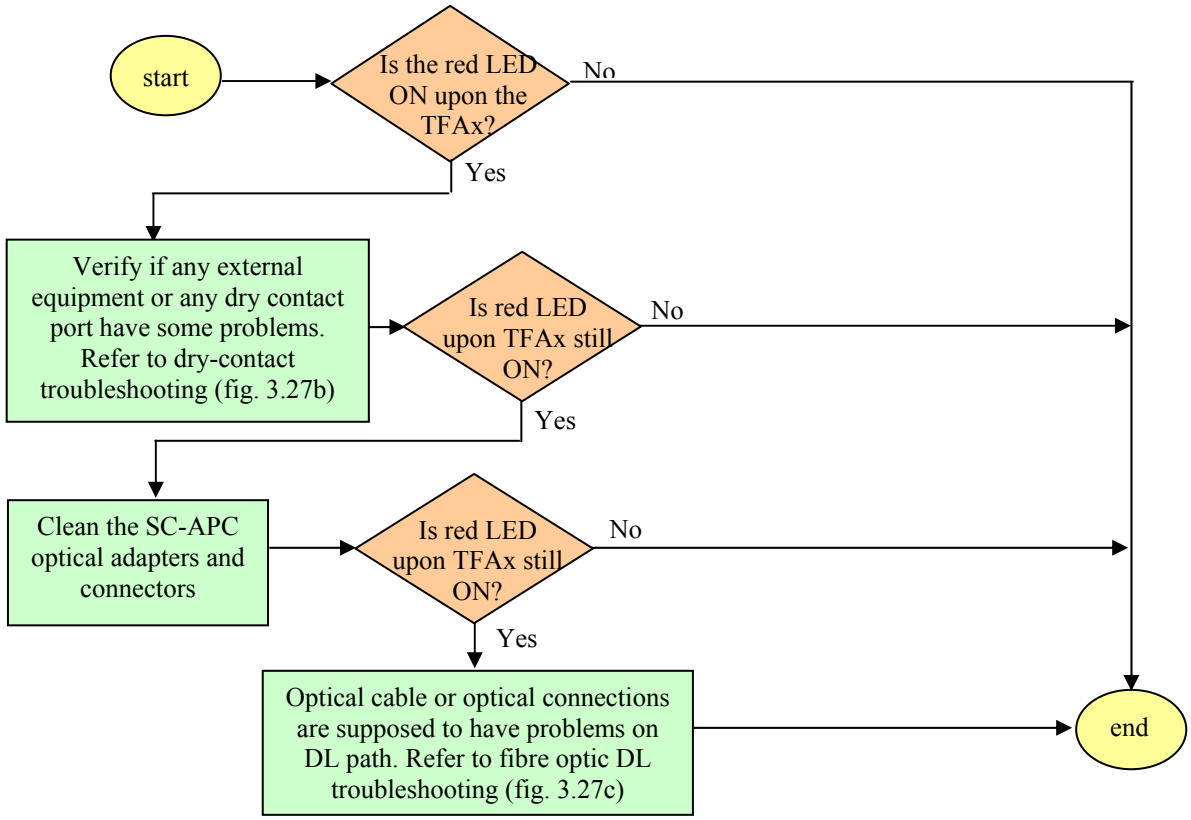


Fig. 3.27 (a): Flow-chart describing the quick troubleshooting procedure on TFAx Case B

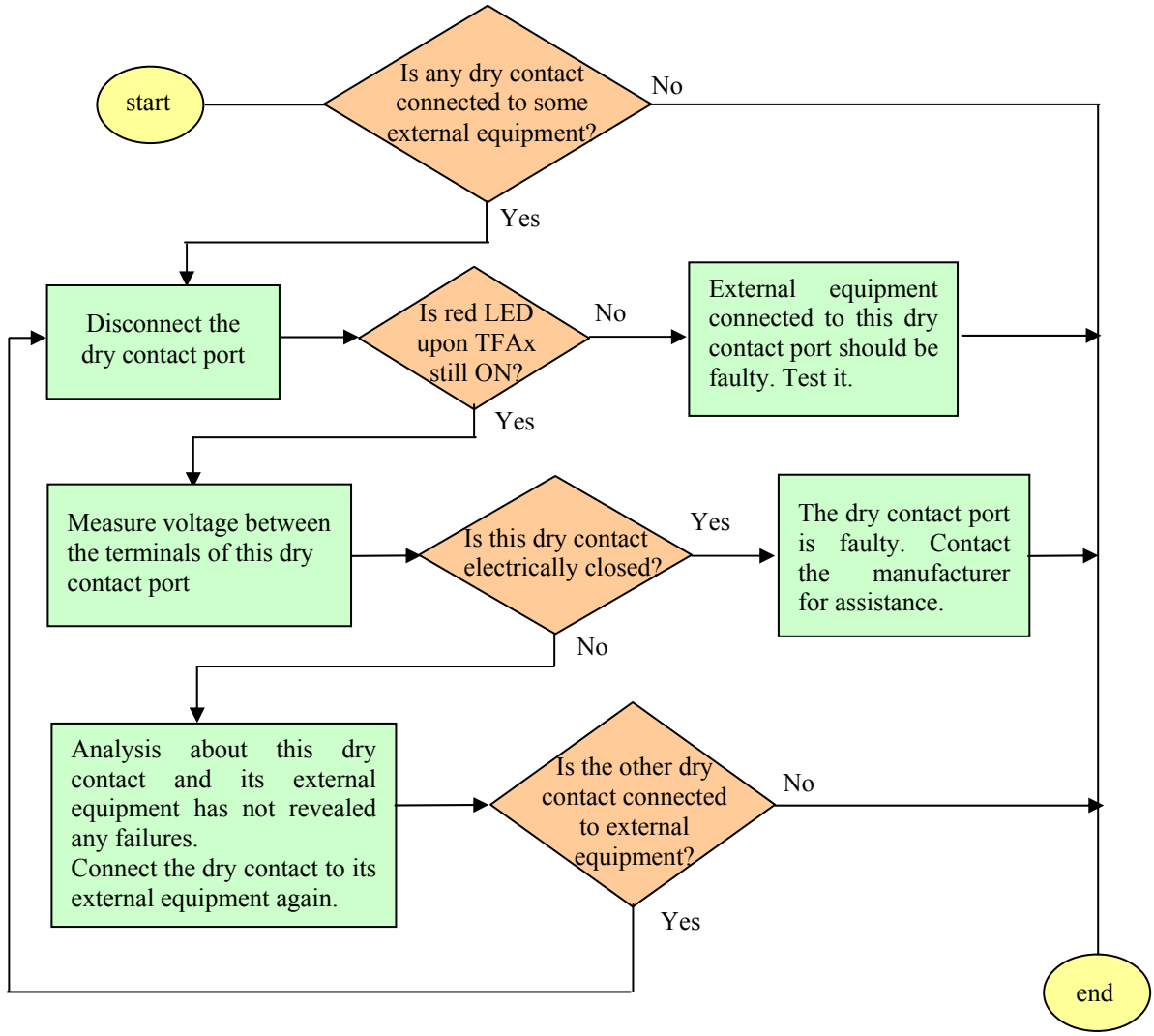


Fig. 3.27 (b): Flow-chart describing the external alarm troubleshooting on Case B TFAx.

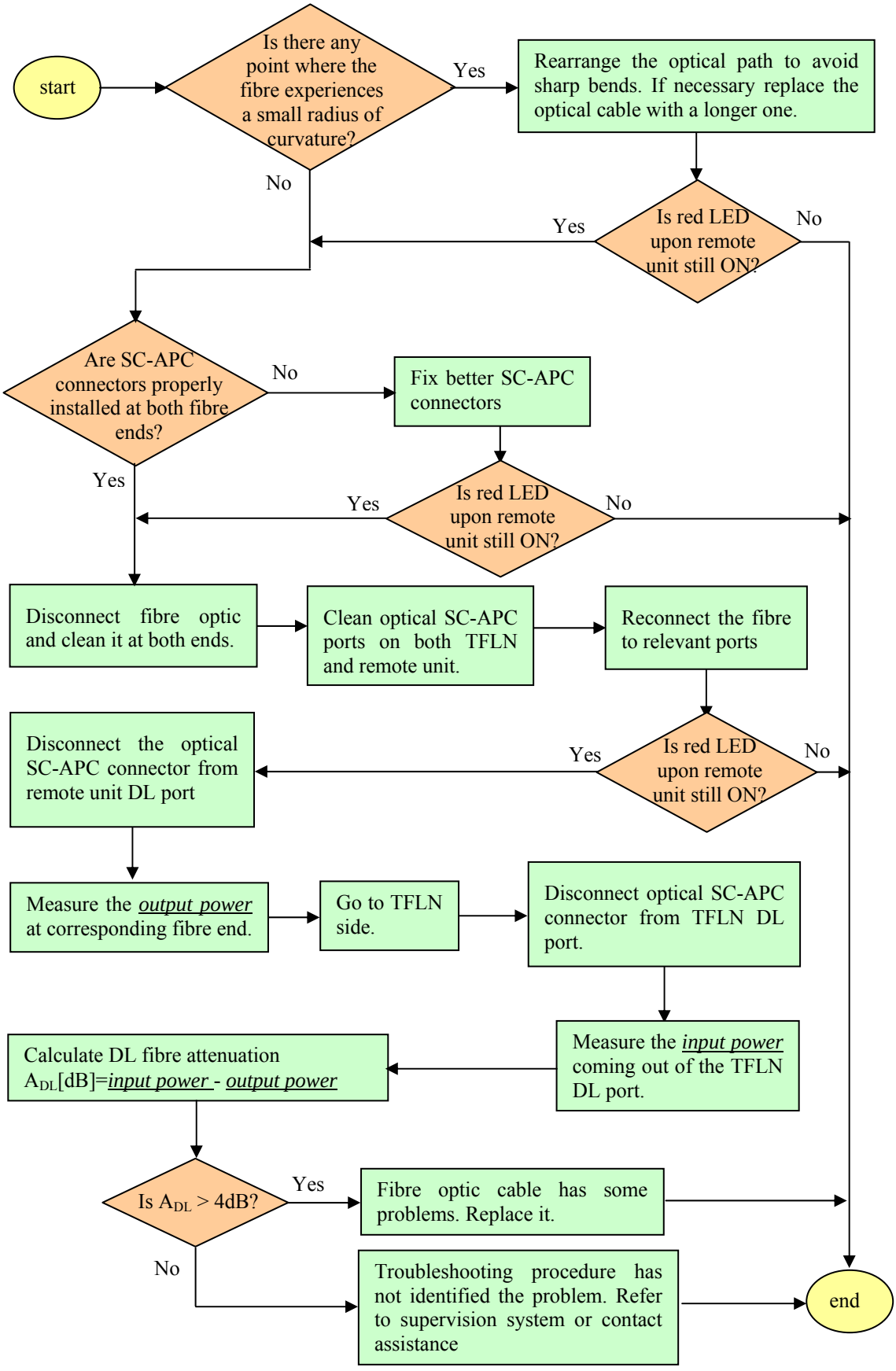


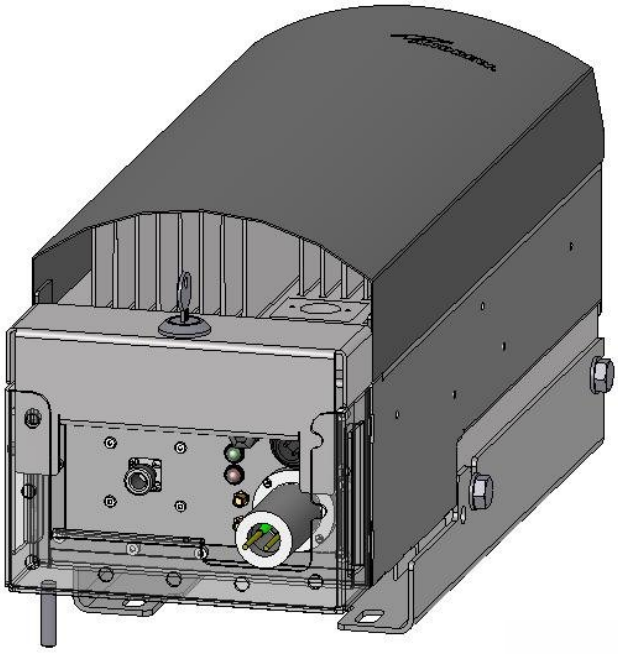
Fig. 3.27 (c): Flow-chart describing the fibre optic DL troubleshooting

3.4. Case F remote unit

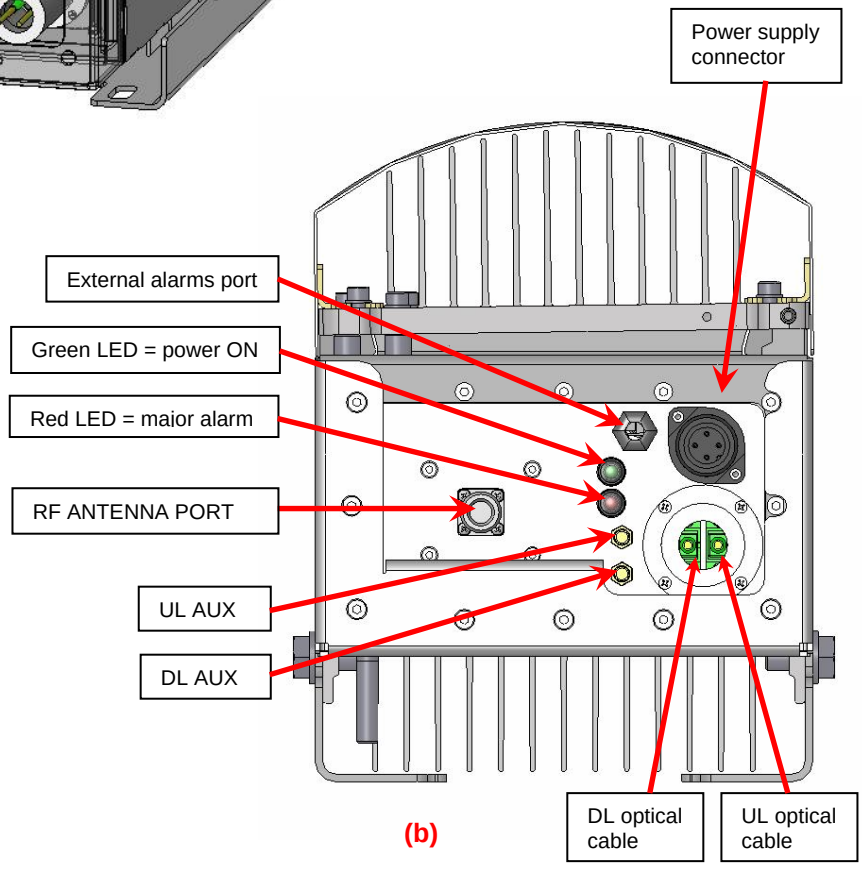
Dimensions and Weight

Dimensions: 546 x 253 x 207 mm
(inches 21.5 x 10 x 8.1)

Weight: please refer to the *Britecell Plus bulletin PA-100595EN* or to the *remote unit dedicated bulletin* in order to know the updated data about the weight of your case-L remote unit.



(a)



(b)

Figure 3.28 : (a) Case-L remote unit; (b) connection panel of the Case-L remote unit

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.

TFAx CaseL

Visual alarms:

Two control LEDs are provided on the Case-L upper side (see fig. 3.29).
The green LED describes the power supply status, while the red LED describes the major Remote Unit failures (please rfer to the table 3.7).

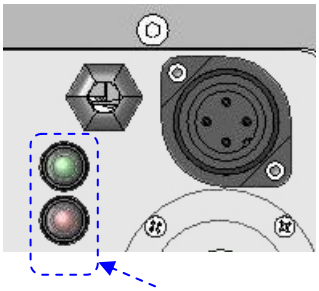


Fig. 3.29 : LED panel on the Case-B warm side

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

Table 3.7: summary of Case-L LEDs meaning

External alarms

The Case-L remote unit can collect the alarm information of any external device, so that the two LEDs of the visual panel will take account both of the alarms of the remote unit itself and of the external devices which have been properly connected. The alarms signals coming from external devices can be carried through proper cables (provided with 0.62” molex plugs), which have to pass through the external alarms port (see picture 3.28) and have to be connected to the proper pins on the motherboard.
Please refer to fig. 3.30 in order to connect the external alarms cables to the proper pins.

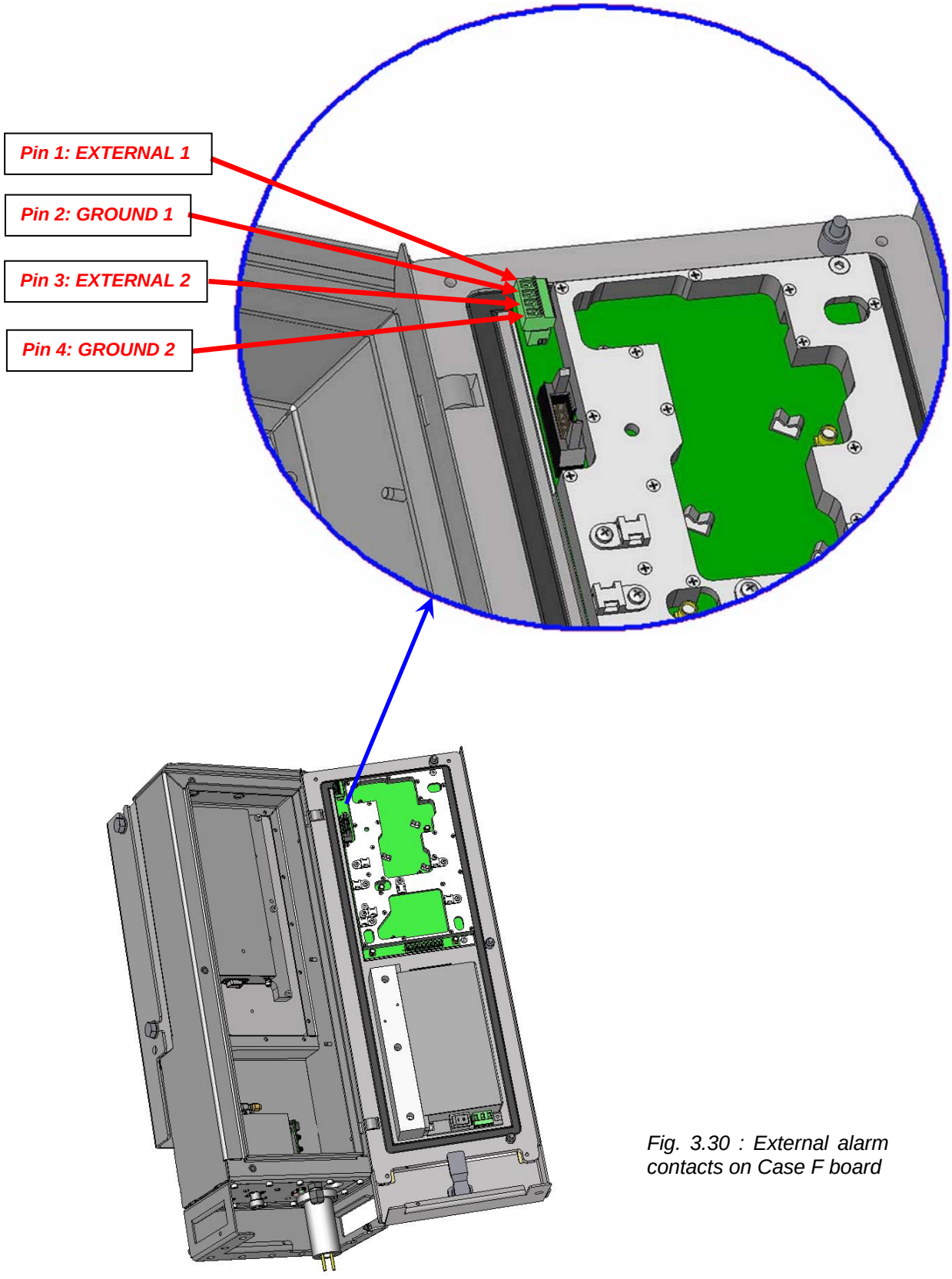


Fig. 3.30 : External alarm contacts on Case F board

Power supply:

The Case-L 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 3.31, 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-L remote unit kit

(a)

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

(b)

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

Figure 3.31 : (a) 85/264 Vac and (b) -36/-72 Vdc connectors on a Case-L Remote Unit

Warnings (to be read before remote units are installed)

Dealing with optical output ports

The Case-L 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-L 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-L 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-L 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, Britecell Plus 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-L installation

Each case-L Remote Unit kit includes:

- 1 Case-L Remote Unit;
- 1 key, required to open the Case-L connector cover
- 1 power supply cable (85 to 264 V_{ac} or -48V_{dc}, 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-L Remote Unit are hereby described:

1- Take down the 2 mounting plates which are fixed to the case L (fig. 3.33a). Fix the two mounting plates to the wall by firmly screwing the anchors.

2. Drill the wall to install four M8 screw anchors (not included) as indicated by the installation drawing shown in fig. 3.33b.

3 –Take two of the hexagonal-head screws included in the kit, and fasten them at the top of the case-L unit (fig. 3.33c, step "1") by using the torque key: while fastening the screws, take care to leave the space required to hang the L-case to the plates. Fasten the screws further only after hanging the L-case. 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 (see fig. 3.33c, step "2").

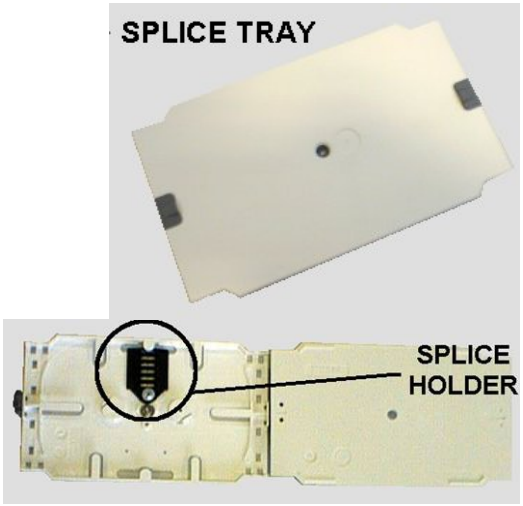


Fig. 3.32: (a) Splice tray. (b) Inside of the splice tray, with the splice holder properly positioned.

4 – Fix a splice holder (not included) inside the proper splice tray (not included; fig. 3.32). Makes the splices between the fiberoptics patchcords coming from the

Case-L 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. Mount the splice tray beside the remote unit.

5 -Turn the key which is provided in order to open the connector cover, and remove the connector cover as in fig. 3.33e. If you need to use the Remote Unit to control alarms on external devices, please refer to fig. 3.30 and to the section "external alarms" in order to perform a proper cabling of the external alarms connections.
6 - Loosen the four screws fixing the cover (fig. 3.33f), and take the cover off. Unscrew the three screws indicated in fig. 3.33g, and open the unit (3.33h).

7 - Connect the antenna RF cable to the RF antenna port (refer to fig. 3.33i).
In order to meet the IP65 compliance, please follow this procedure to carry out the optical UL / DL connections. During these operations, take care not to bend the fibers too much.

- Take off the *PG13,5 Nut*, the *split-seal*, the *PG 13,5*, and the *pipe connection*.
- Make the optical patchcord pass through the *PG 13,5 nut*, the *PG 13,5* and the *pipe connection*. Connect the UL and DL optical connectors to the corresponding UL and DL adapters the unit.
- Screw the *pipe connection* to the *unit*. Fasten the *PG 13,5* to the *pipe connection*.
- House the fiber optic cables (Ul and DL) on one half of the *split-seal*.
- Close the two halves of the *split-seal*, while paying attention not to stretch the fibers.
- Insert the *split-seal* inside the *PG13,5*. Screw the *PG 13,5 nut* onto the *PG 13,5*.

8 - 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 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 L start-up"*).

9 - Close the cover, and fasten the 3 screws indicated in fig. 3.33g. Fasten the 4 screws indicated in fig. 3.33f. Mount both the external cover and the connector cover. Turn the key to close the connector cover.

TFAx Case-L start-up

Before the Case-L 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-L Remote Unit has been switched on, its behaviour could be checked by turning the key, removing the connector 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 3.7 In case 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-L troubleshooting

Faults can be revealed by LEDs on the Case L front panel as well as by the LMT software or the TSUN supervision system.
Both the LMT software and the TSUN supervision interface 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 the LMT software or the supervision system.

Britecell Plus modules are designed in order to exchange information each other: each remote unit can receive failure notifications from their external equipment through dry-contact connections. Moreover, each TFAx constantly monitors the optical signal received from its TFLN unit, so as to control optical losses.
Table 3.8 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.

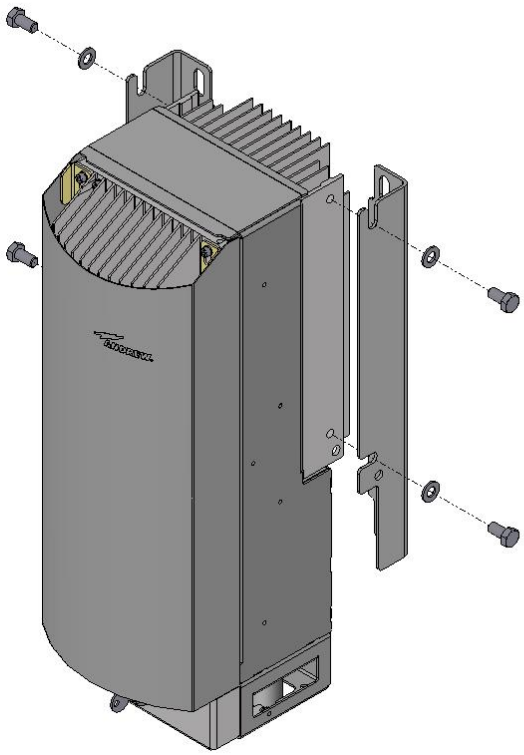


Fig. 3.33 (a): Side plates to be taken down from the case L remote unit

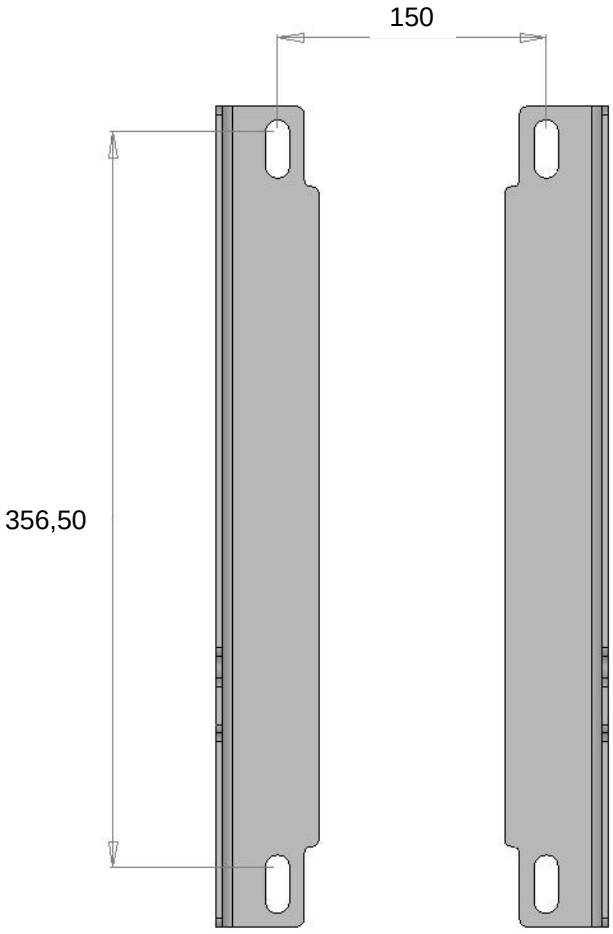


Fig. 3.33 (b): Layout for the installation of the case L remote unit plates

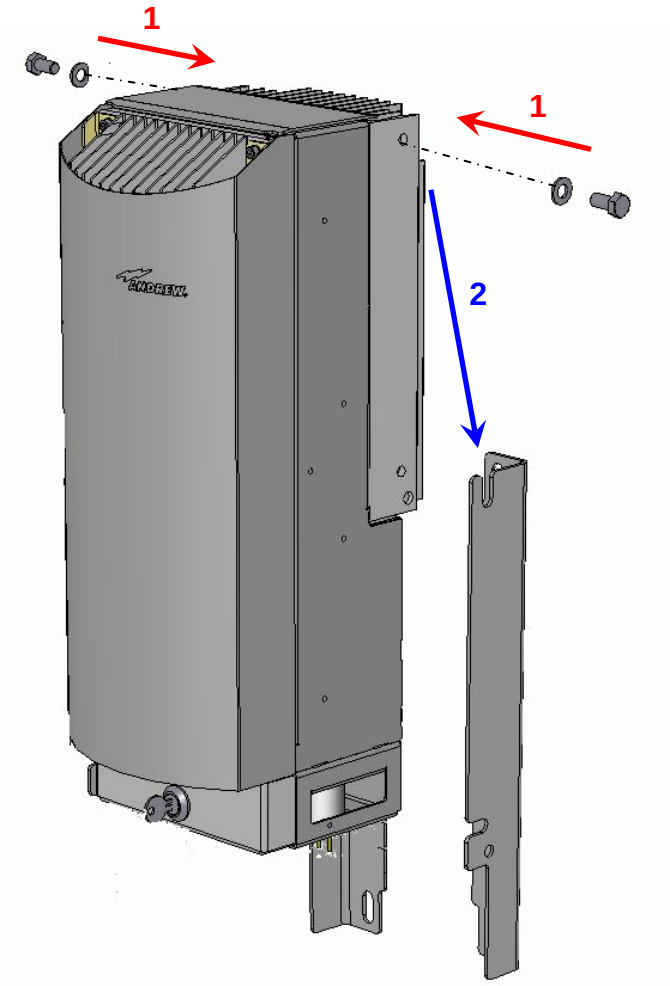


Fig. 3.33 (c): When fastening the upper screws (1), leave the space required in order to hang the case (2) to the plates which have just been fixed to the wall

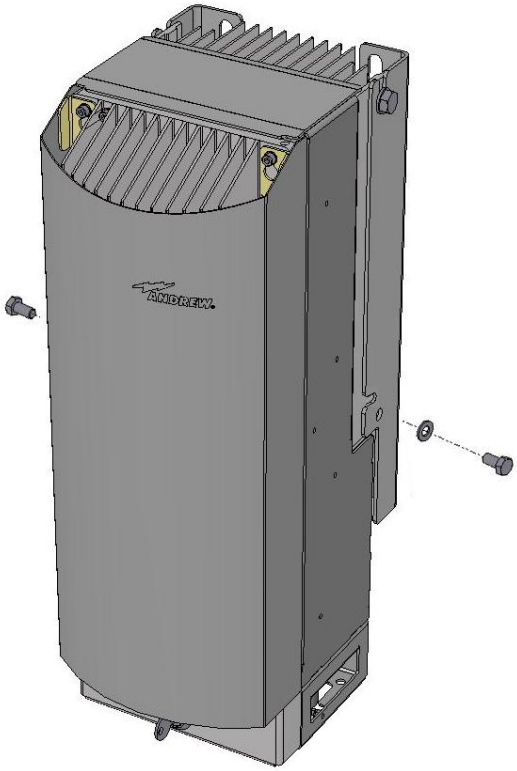


Fig. 3.33 (d): After hanging the case to the plates fixed to the walls, fasten the lower screws.

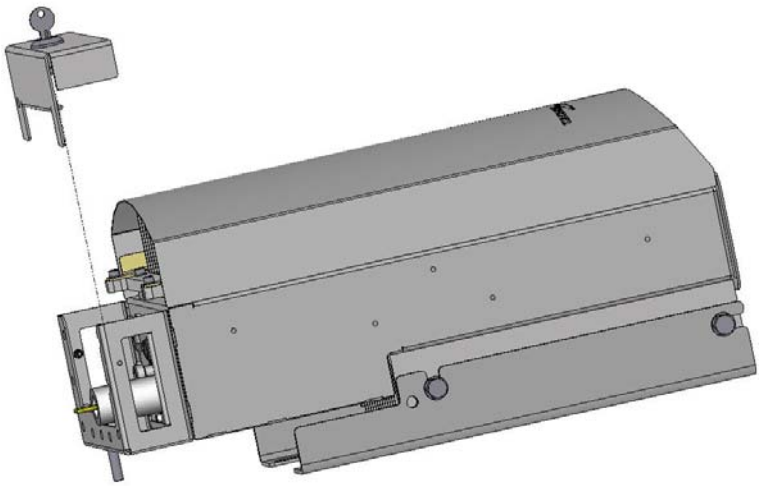


Fig. 3.33 (e): Open the connector cover

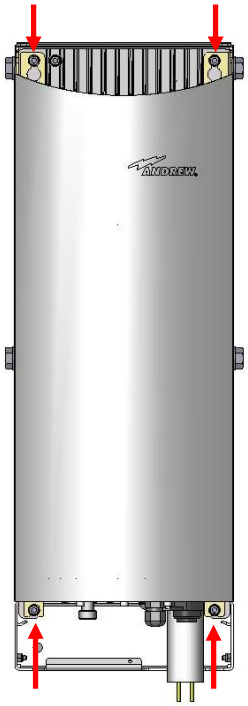


Fig. 3.33 (f): loosen the four screws and remove the external cover

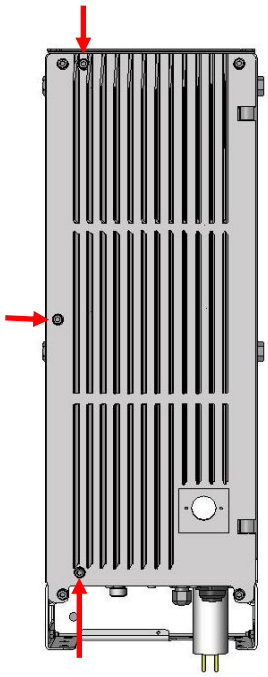


Fig. 3.33 (g): after removing the external cover, loosen the three screws

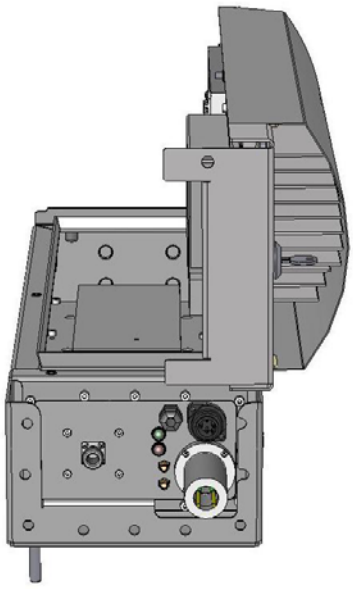
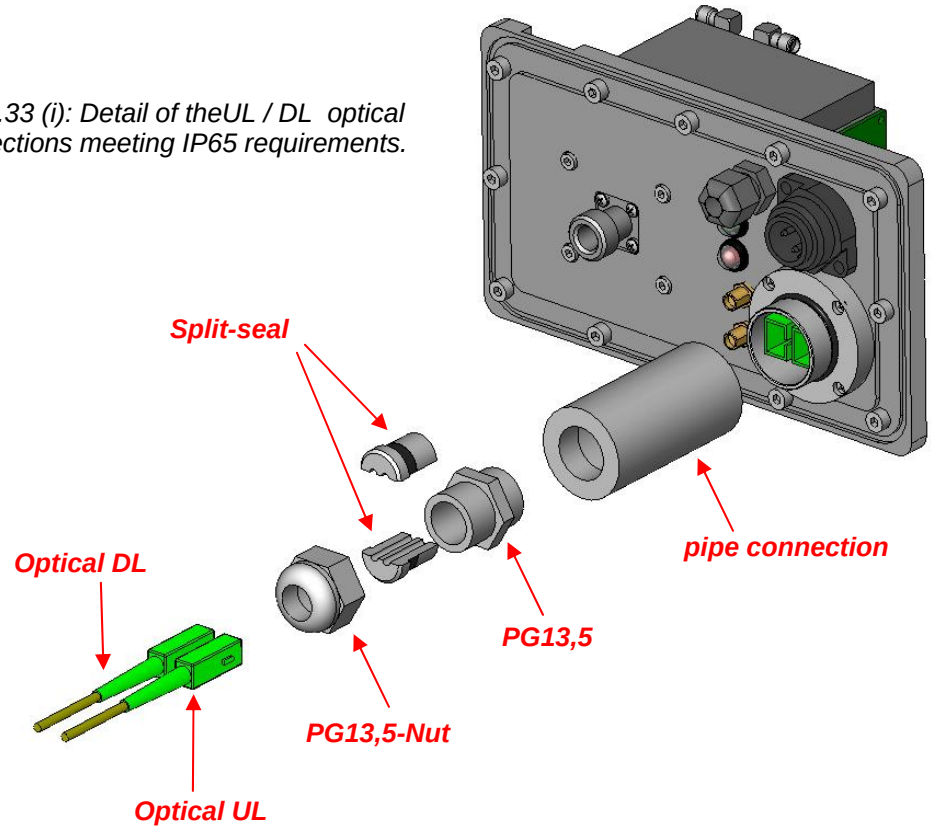


Fig. 3.33 (h): open the cover of TFAx Case-L

Fig. 3.33 (i): Detail of theUL / DL optical connections meeting IP65 requirements.



ALARM CODE (TSUN description)	ALARM DESCRIPTION	ACTIVE LED	SUPERVISION PRIORITY LEVEL	ACTION RECOMMENDED	RELÉ PRIORITY LEVEL (subrack)
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
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
DL UMTS band alarm	HW failure on the DL UMTS band RF section	RED	CRITICAL	Return the unit	MAJOR

Table 3.8: Description of the alarms of the TFAN Case-B Remote Unit, as they are presented on LMT or Supervision Interface

As 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 dB. In case optical losses are in the 3dB- 4dB range, the AGC is said to be "out of range": the whole system still work, but AGC is near to its borderline levels. The DL power LED switches on when the estimated optical losses are >4dB, 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.

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 3.34a)
In case the red LED is ON, please follow these steps:

5. First of all, refer to external alarm troubleshooting in order to understand whether the alarm can depend on any external equipment failure or not.
6. In case external alarm troubleshooting has not revealed any failure, clean the optical adapters
7. 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.
8. If previous actions didn't make the LED switch off replace the unit with a new one or contact for assistance.

External-alarm troubleshooting

(The following procedure is summarized by the flow-chart in fig. 3.34b)

This procedure needs to be considered if at least one external alarm terminal is connected to some external equipment (see section "external alarms"). If not, return to main troubleshooting procedure.

These steps aim to detect any failure inside the external equipment or inside the external alarm terminal. If the external alarm terminals don't reveal any equipment malfunction or any terminal failure, return to the main troubleshooting procedure.

TFAx CaseL

For any external alarm terminal connected to some external equipment, follow these steps:

4. Disconnect it, and check the TFAx LED status after the disconnection.
5. If the red LED has switched off, external equipment connected to the alarm terminal should be faulty. Please test it.
6. If the TFAx red LED still remains on after the disconnection, measure the voltage between the poles of the alarm terminal.
   c. If the poles of the alarm terminal are electrically closed, the circuit board should have any problem. Contact the manufacturer for assistance.
   d. If the poles of the alarm terminal are open, this means neither the analysis of this alarm terminal nor the one of its external equipment has revealed any failure. Re-connect this alarm terminal to its external equipment. In case the TFAx has another alarm terminal connected to some external equipment and still to be checked, apply the whole procedure (i.e,, the steps 1-3) to this still unchecked terminal.

Fibre optic DL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 3.34c)

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)
   c. If A_{DL} > 4dB, then the fibre optic cable has some problems. Replace it with a new one.
   d. If A_{DL} < 4dB troubleshooting procedure has not identified the problem. Refer to supervision system or contact assistance.

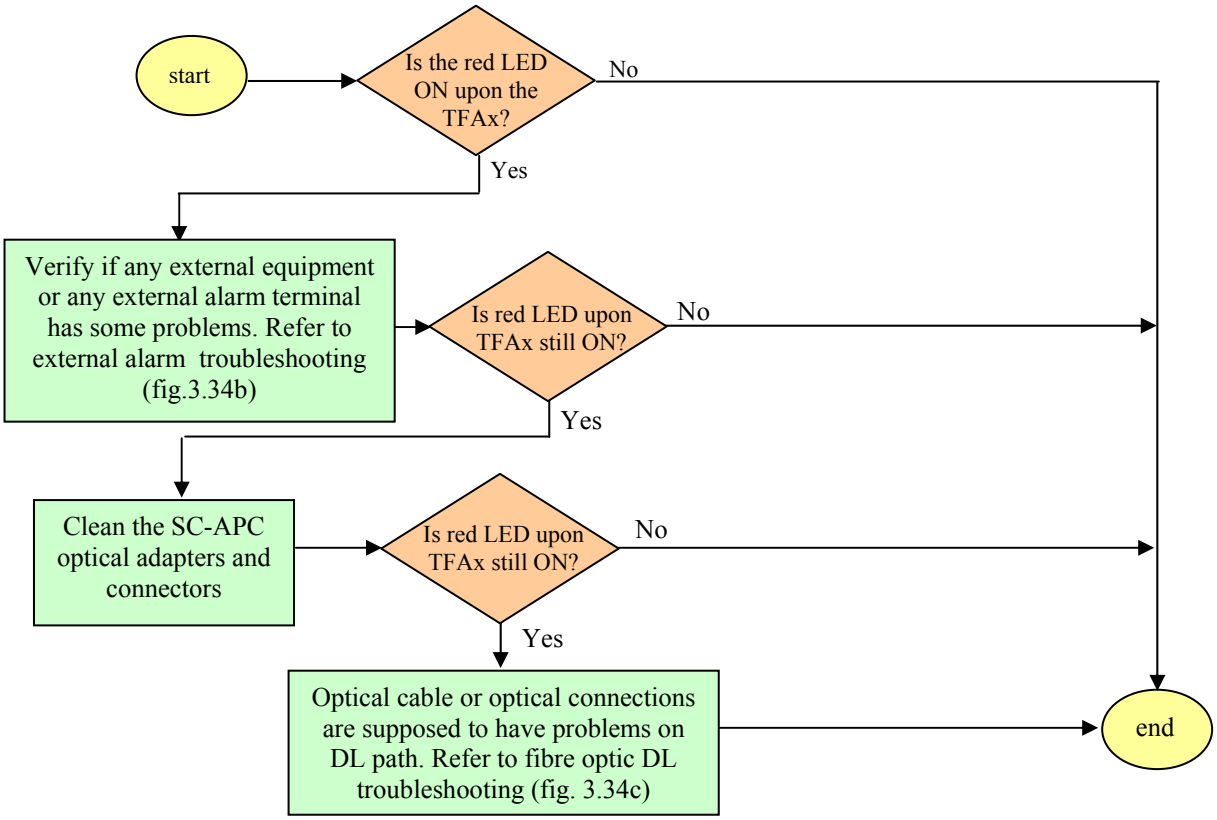
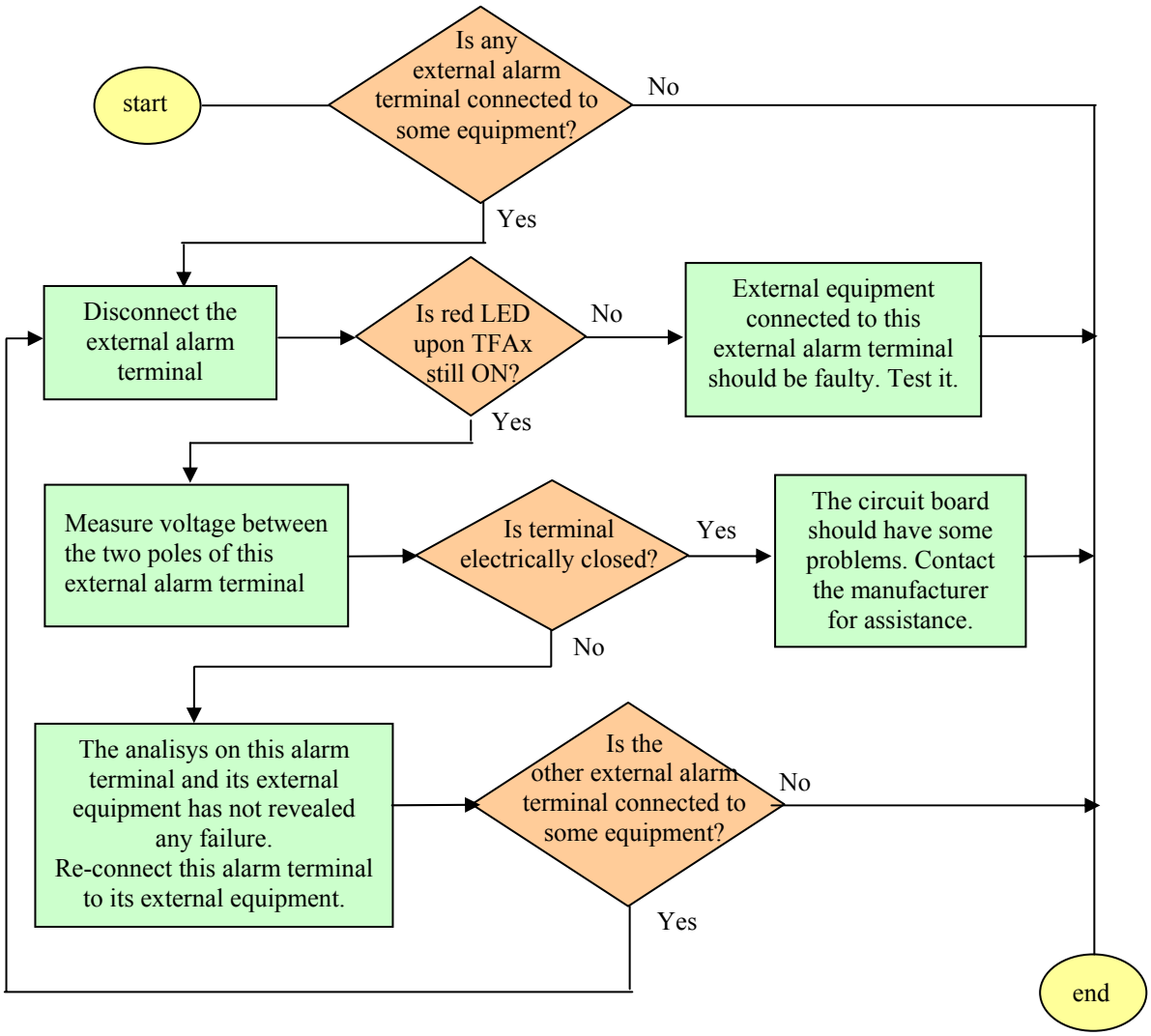


Fig. 3.34a: Flow-chart describing the quick troubleshooting procedure on Case LTFAx



Picture. 3.34b: Flow-chart describing the external alarm troubleshooting on Case L TFAx

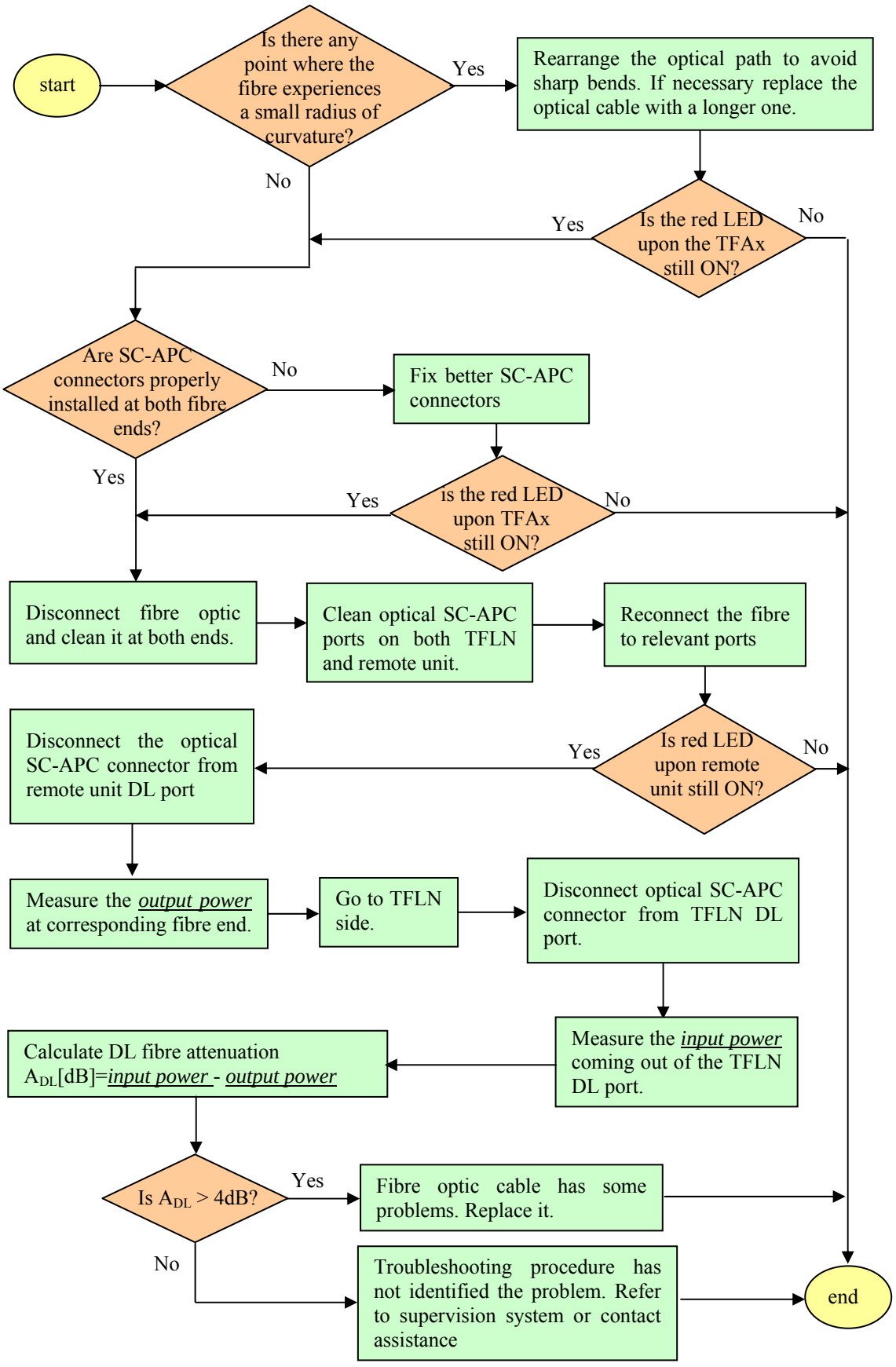


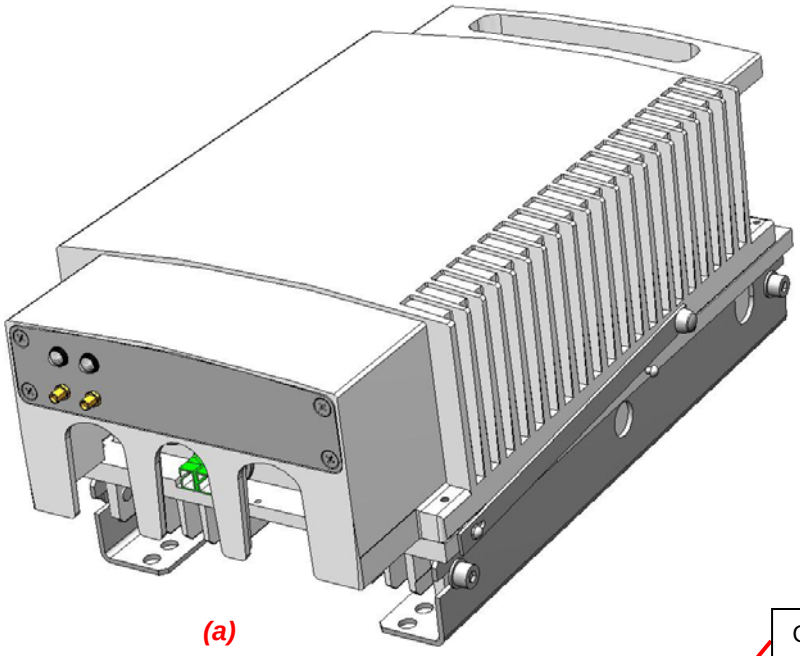
Fig. 3.34c: Flow-chart describing the fibre optic DL troubleshooting

3.5. Case F remote unit

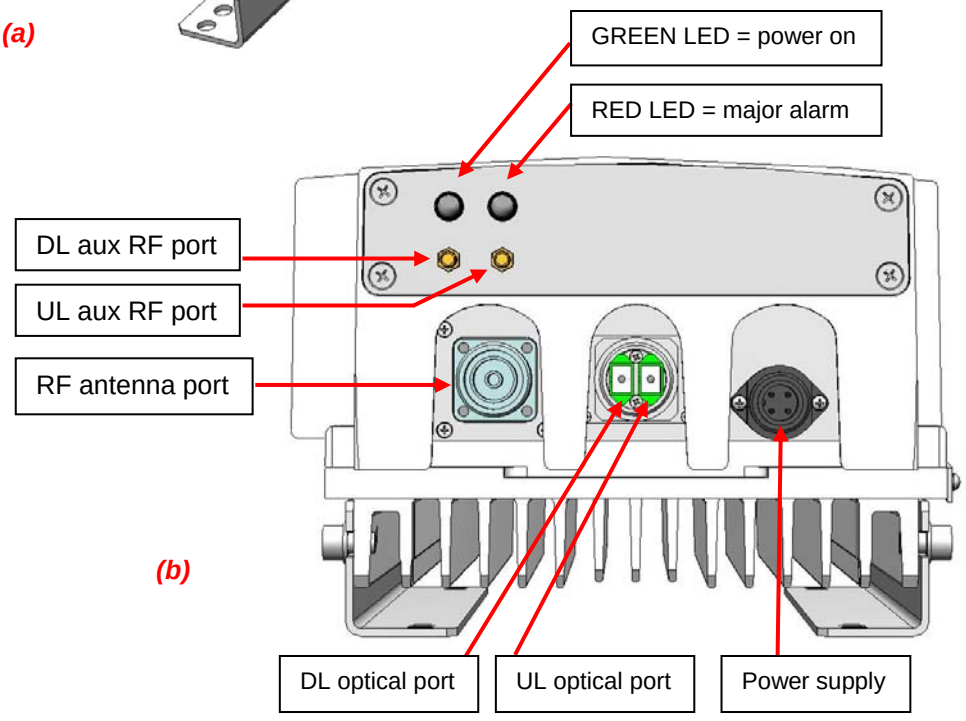
Dimensions and Weight

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

Weight: please refer to the *Britecell Plus bulletin PA-100595EN* or to the *remote unit dedicated bulletin* in order to know the updated data about the weight of your case-F remote unit.



(a)



(b)

Fig. 3.35: (a) Case F remote unit ;
(b) connection panel of the Case F remote unit

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. 3.36).
The green LED describes the power supply status, while the red LED describes the major Remote Unit failures (fig. 3.9).

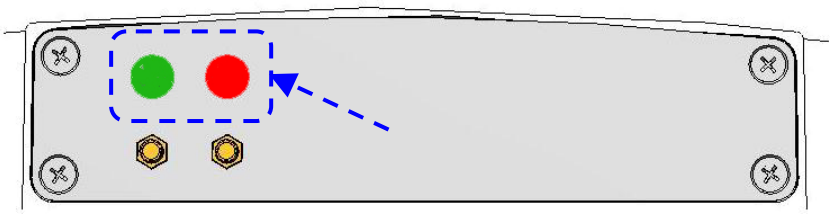


Fig. 3.36 : LED panel on the Case F warm side

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

Table 3.9: summary of Case F LEDs meaning

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 3.37, 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.

(a)

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

(b)

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

Figure 3.37 : (a) 85/264 Vac and (b) -36/-72 Vdc connectors 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, Britecell Plus 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 V_{ac} or -48V_{dc}, 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. 3.39a. 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. 3.39b, step "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. 3.39b, step "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. 3.39b, step "3").

3 – Fix a splice holder (not included) inside the proper splice tray (not included, fig. 3.38). 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. 3.39c), 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 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

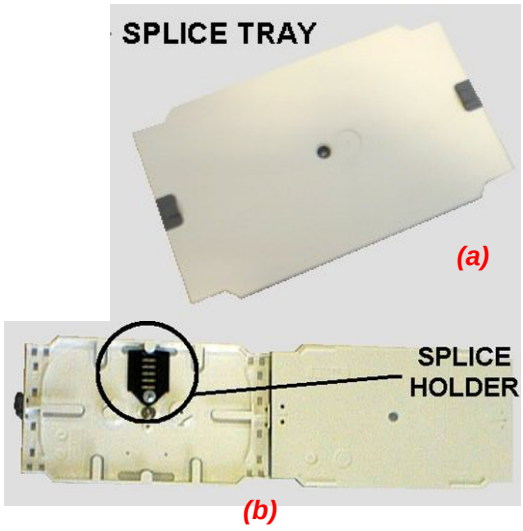


Fig. 3.38: (a) Splice tray. (b) Inside of the splice tray, with the splice holder properly positioned.

Case F *start-up"*).

5 - Close the unit, and fasten the 4 screws indicated in fig. 3.39c 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 both LEDs have to be the one reported in table 3.9. 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).

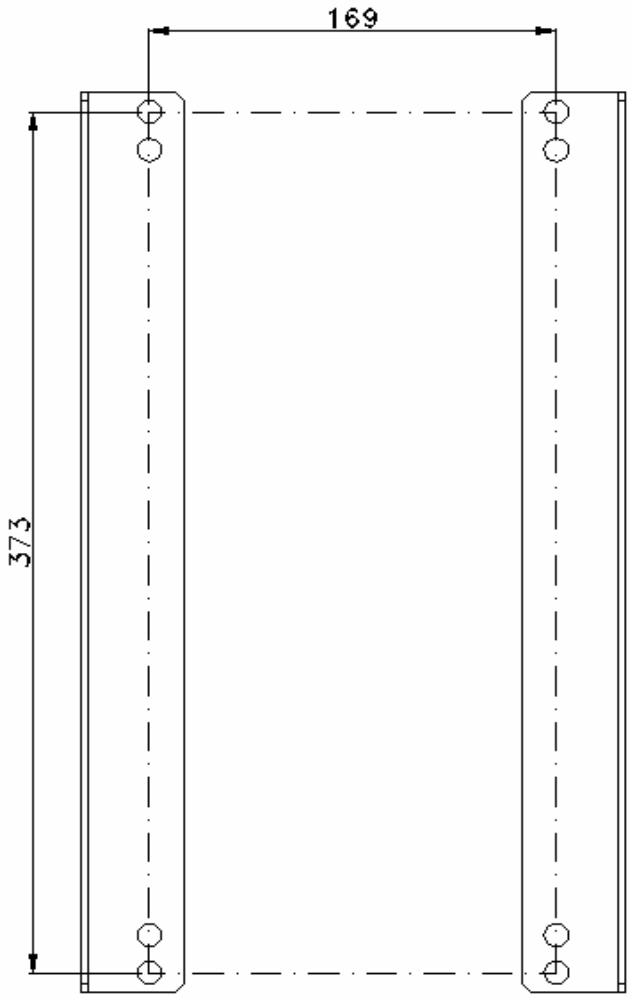


Fig. 3.39 (a) : layout for the installation of the Case F plates

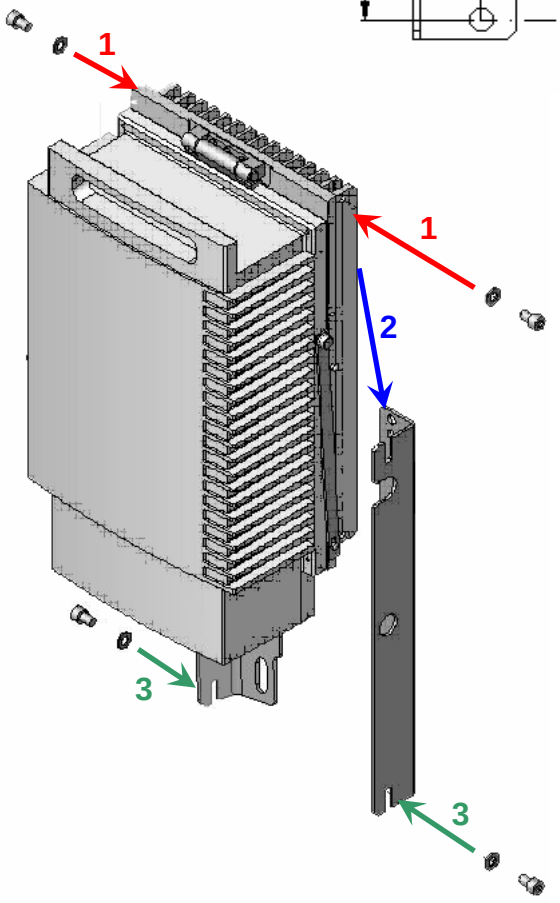


Fig. 3.39 (b) : while fastening the two hexagonal screws to the top of the case (step "2"), take care to leave the space required to hang the case to the plates (step "2") Then fasten the other two hexagonal screws to the bottom of the case (step "3")

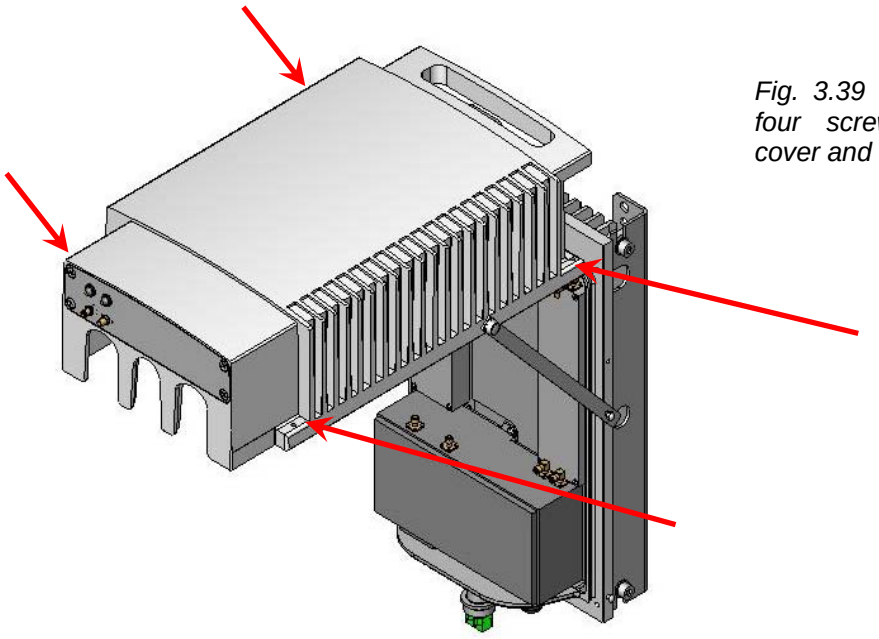


Fig. 3.39 (c) : loose the four screws fixing the cover and open the unit

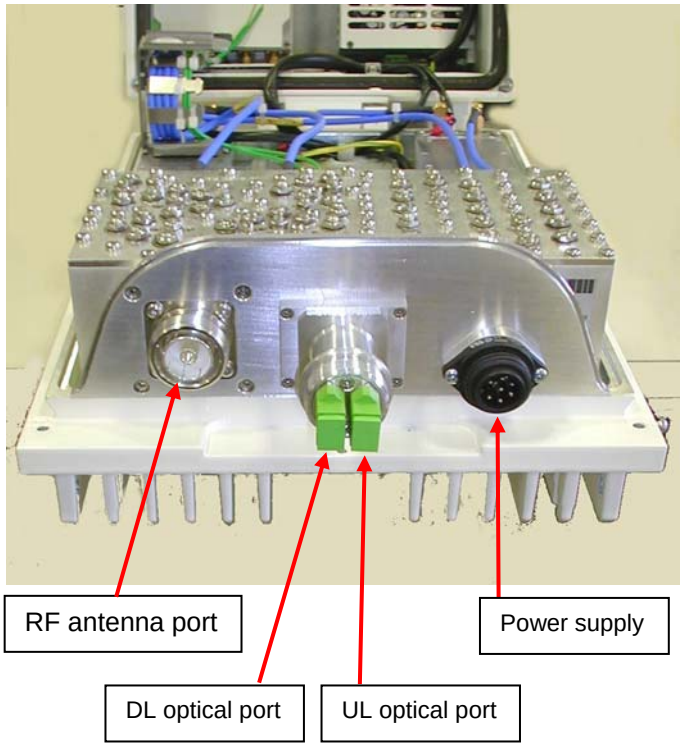


Fig. 3.39 (d) : power supply, optical and RF connections on the TFAx Case F

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.
Britecell Plus 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 3.8 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.

ALARM CODE (TSUN description)	ALARM DESCRIPTION	ACTIVE LED	SUPERVISION PRIORITY LEVEL	ACTION RECOMMENDED	RELÉ PRIORITY LEVEL (subrack)
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 band alarm (not implemented on TFAH 19)	HW failure on the DL RF low band	RED	CRITICAL	Return the unit	MAJOR
DL high band alarm (not implemented on TFAH 80 and TFAH 85)	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 3.10. Description of the alarmi of the TFAx Case F Remote Unit, as they are presented on LMT or Supervision Interface

As 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 dB. In case optical losses are in the 3dB- 4dB range, the AGC is said to be "out of range": the whole system still work, but AGC is near to its borderline levels. The DL power LED switches on when the estimated optical losses are >4dB, 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.

Quick troubleshooting procedure

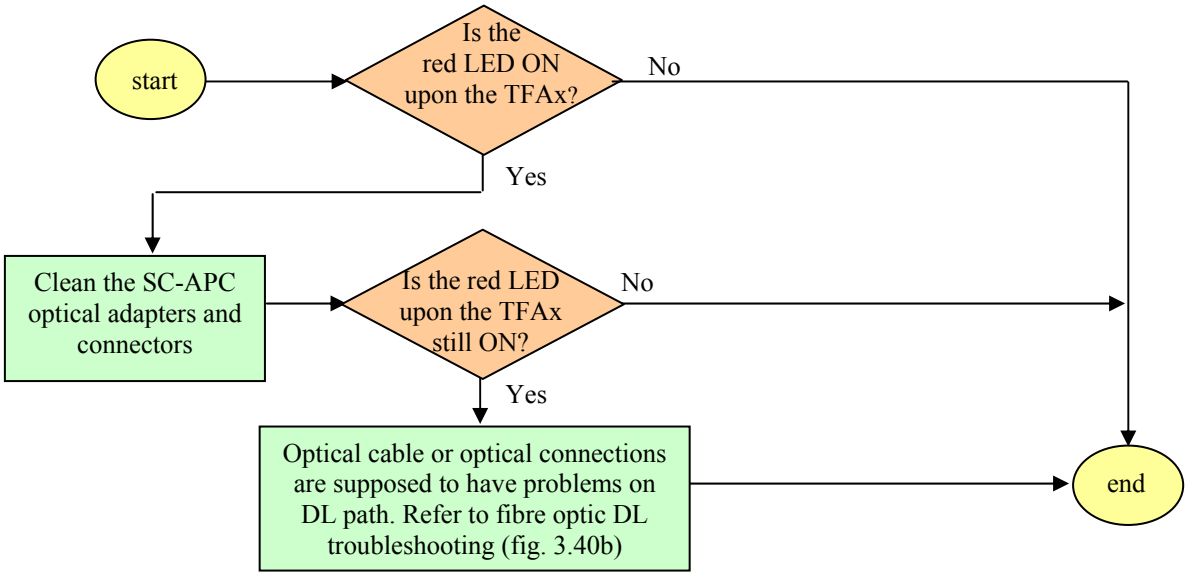
(The following procedure is summarized by the flow-chart in fig. 3.40a)
In case the red LED is ON, please follow these steps:

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. 3.40b)

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.



Picture. 3.40(a): Flow-chart describing the quick troubleshooting procedure on Case F TFAx

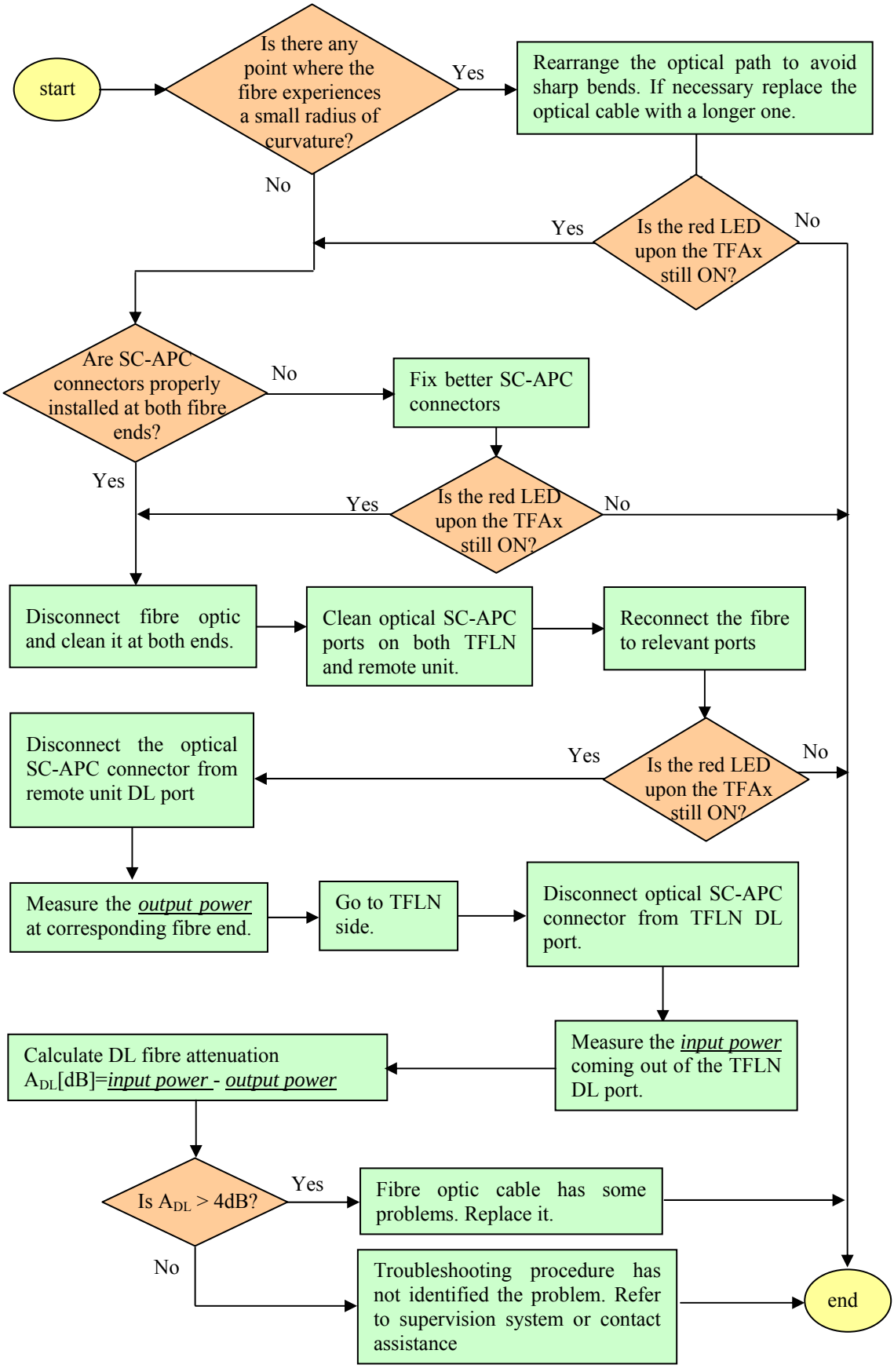


Fig. 3.40(b): Flow-chart describing the fibre optic DL troubleshooting

3.6. Wi-Fi Booster TFBWx

Module name:

Wi-Fi booster

TFBWx

Description

Britecell Plus system allows to distribute the WLAN services (802.11b and g) through the auxiliary channels of the remote units, while concentrating all the Access Points together with the Master Unit.
The TFBW booster has to be connected to the remote unit auxiliary ports and to a pair of WLAN dedicated antennas (one transmitting and the other one receiving).
Moreover, an additional Wi-Fi booster (*slave TFBW*) can be cascaded to the first one *(master TFBW)* so as to obtain a larger WLAN coverage.

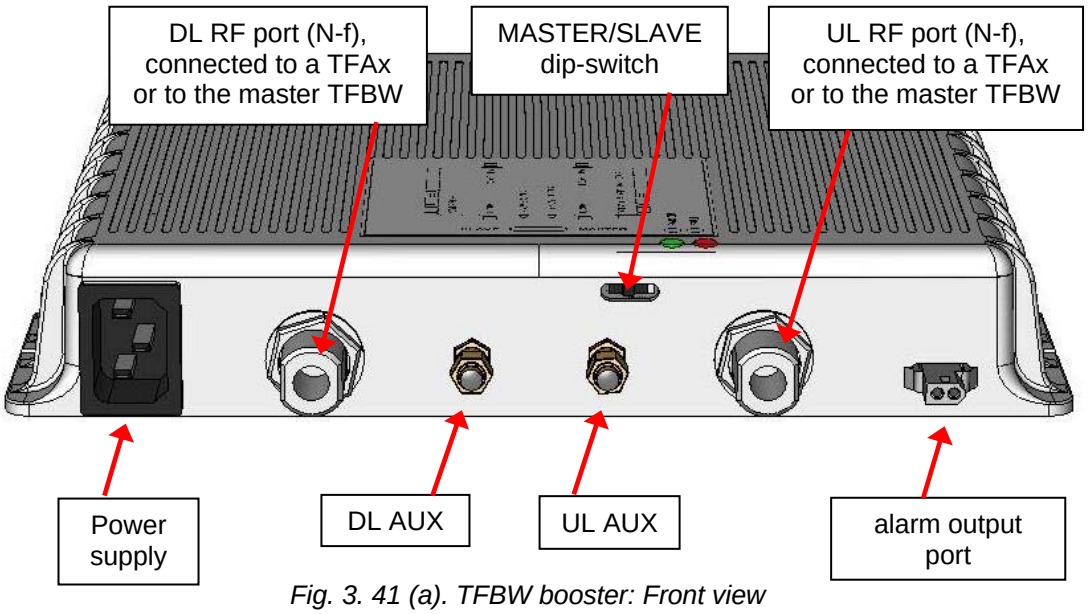


Fig. 3. 41 (a). TFBW booster: Front view

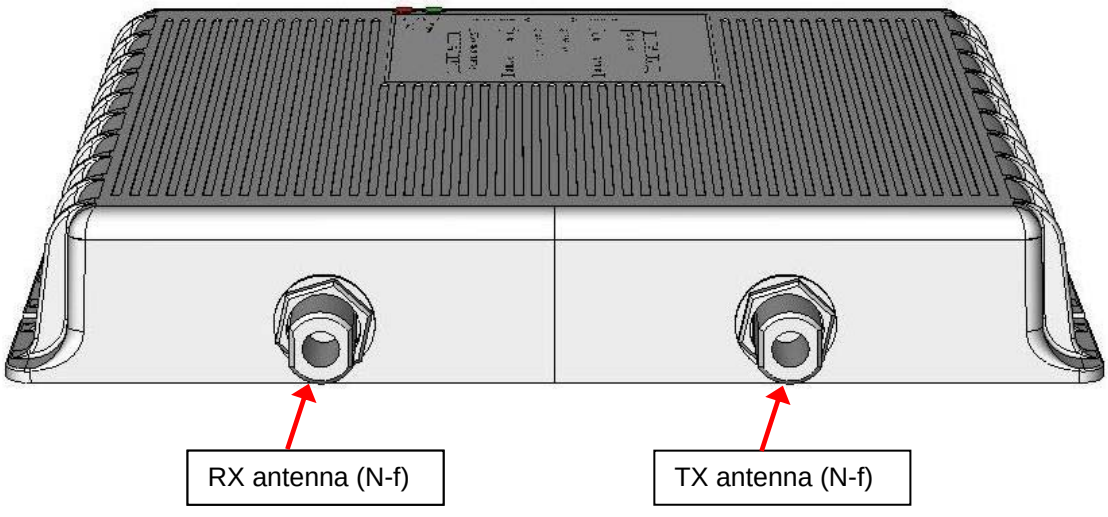


Fig. 3. 41 (b). TFBW booster: back view

Dimensions and weights

Dimensions: mm 38 x 240 x 200
(inches 1.5 x 9.4 x 7.9)
Weight: please refer to *Bulletin PA-100596EN* in order to know the updated data about the TFBW weight.

Visual alarms:

Two control LEDs are provided on the TFBW front side (fig.3.42).
The green LED describes the power supply status, while the red LED describes the major booster failures.

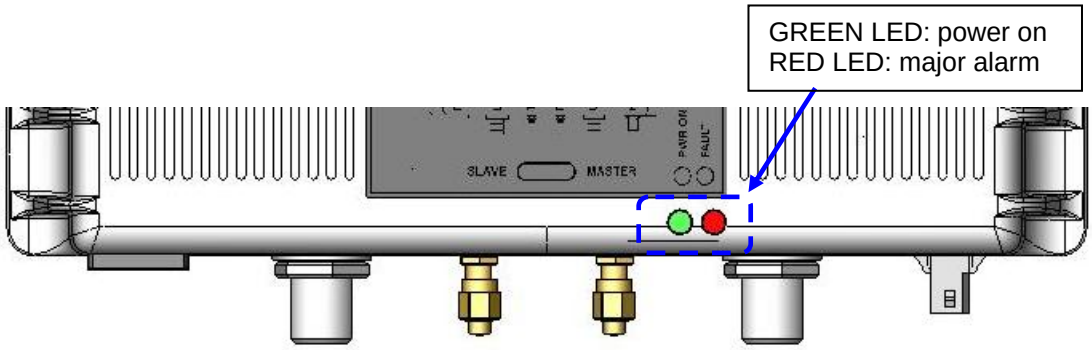


Fig. 3.42: LED alarms on the TFBW warm side

Dry contact alarms:

TFBW is provided with an alarm output port (fig. 3.41), which can be connected to one of the dry-contacts ports available on TFAx remote units.
When a TFBW booster is been connected to the relevant TFAx remote unit through dry-contact ports, any major alarm affecting the TFBW booster will be conveyed to the remote unit itself, and signalled by the red LED both on the TFBW warm side (fig. 3.42), and on the TFAx remote unit.
Moreover, the LMT software and the TSUN supervision interface (please refer to TFBW troubleshhoting) will consider any TFBW major alarm as an external alarm of the TFAx remote unit the TFBW booster is connected to.

Power supply:

TFBW WLAN booster is available both in a universal mains version (85 to 265 Vac powered: fig. 3.43a) and in a negative supply version (-72 to -36 Vdc powered: fig. 3.43b). The power consumption of each TFWB module is 16W max.

Warnings (to be read before the TFBW booster is installed)

Choosing a proper installation site for the WLAN booster

- WLAN boosters are to be installed as close as possible to the radiating antennas, in order to minimize coaxial cable length.
- When positioning the TFBW booster, consider that the position of the related antennas should guarantee at least a 50dB isolation between the antennas and the booster itself
- The TFBW booster is intended to be fixed on walls, false ceilings or other flat vertical surfaces

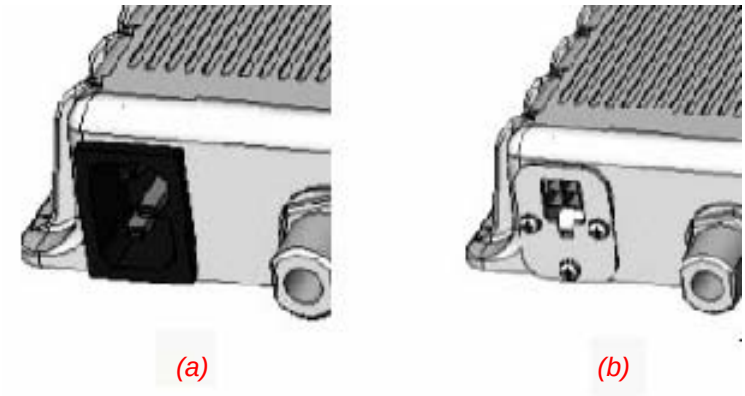


Fig. 3.43 : (a) IEC connector on the rear side of a 220V_{ac}-powered TFBW booster. (b) 4-pole connector on the rear side of a -48 V_{dc} -powered TFBW

TFBW installation and start-up

The TFBW booster can be fixed on walls, false ceilings or other flat vertical surfaces, either directly or through a TKA01 installation kit (optional).

Installing a TFBW booster WITHOUT the TKA01 kit

The TFBW kit includes:

- 1 TFBW booster
- 2 50Ω SMA loads
- 2 RF jumpers (SMA-m; N-m), 1m-long
- 1 alarm cable, 1m-long
- mains plug or -48 Vdc plug (according to the chosen model).

To install the TFBW booster, please follow the next steps:

1. drill into the wall so as to install four M4 screw anchors (not included) according to the dimensions indicated by the installation drawing in fig. 3.45a.
2. fix the TFBW booster to the wall by firmly screwing the anchors.
3. connect the RF cables according to what planned by the designer. Use a specific torque wrench to fix each cable to the relevant ports.

4. connect the TFBW to the power supply. If the TFBW booster works properly, both the green and the red LEDs should turn on for a while and then switch off. If the LED red does not switches off, please contact the manufacturer.

After installing the booster, please refer to the section *TFBW booster start-up* in order to start-up the system properly.

Installing a TFBW booster WITH the TKA01 kit

The TFBW kit includes:

1. a TFBW booster
2. a 50 Ω load
3. a VDE connector or a -48 Vdc plug (according to the chosen model)

The TKA01 kit includes:
(please refer to fig. 3.44)

A. 4 screw anchors (fixing the wall bearing to the wall)
B. 5 screw anchors (fixing the TFAx case A to the wall mounting box "C")
C. A wall mounting boc
D. a splice holder (pleased note that this standard TKA01 accessory is not used for mounting the TFBW booster, since it has no optical

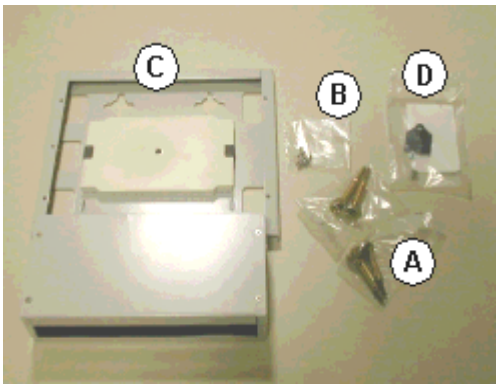


Fig. 3.44: The TKA01 installation kit

Once you have chosen the position where the TKA01 mounting case is going to be mounted, please follow these instructions:

1. Unscrew the 4 screws which lock the lower cover of the TKA01 wall bearing (see fig. 3.46a)
2. In order to install the M4 screw anchors (included) which shall hold up the TKA01 wall bearing, drill into the wall according to the TKA layout shown in fig. 3.45b.
3. Fix the TKA01 wall bearing by firmly screwing the anchors.
4. Fix the TFBW booster to the wall bearing by using the included screws (fig. 3.46b).
5. Connect the RF cables coming from the transmitting and the receiving antennas to the proper RF antenna ports (fig. 3.41b). Connect the UL and DL RF ports (fig.3.41a, 3.46c). If the TFBW booster works as a master unit and supports a slave one, connect also the DL and UL AUX ports.
6. Connect the alarm output port (fig. 3.41a) if you want the major alarms on the TFBW booster could be checked through the relevant remote unit

and controlled through the LMT software or through the TSUN supervision interface.

7. If the booster -48 Vdc powered (fig., use the -48 Vdc plug (included) in order to connect the unit to the -48 Vdc mains. If the booster is 85/264 Vac-powered, fix the 85/264 Vac plug (included) on to a power cord (not included), and use this cable in order to connect the unit to the mains. If the TFBW booster works properly, both the green and the red LEDs should turn on for a while and then switch off. If the LED red does not switches off, please contact the manufacturer.

Fix the lower cover by fastening the 4 screws (fig.3.12f).

TFBW booster troubleshooting

The red LED on the TFBW warm side (fig. 3.45) reveals a power amplifier bias fault. If such a fault occurs, the alert notification is signalled also by the switching on of the red LED on the relevant TFAx remote unit, provided that the TFBW alarm output port has been properly connected to the TFAx external alarm connector (fig. 3.46).

If controlled through the LMT software or through the TSUN supervision interface, the TFBW power amplifier fault appears as an external alarm of the TFAx remote unit to which its alarm output port is connected. Please refer to the LMT or to the TSUN supervision manual for further details.

When the TFBW power amplifier fault is signalled by the red LED on the TFBW booster and on its relevant remote unit, or by the LMT software or the TSUN interface, please contact the manufacturer.

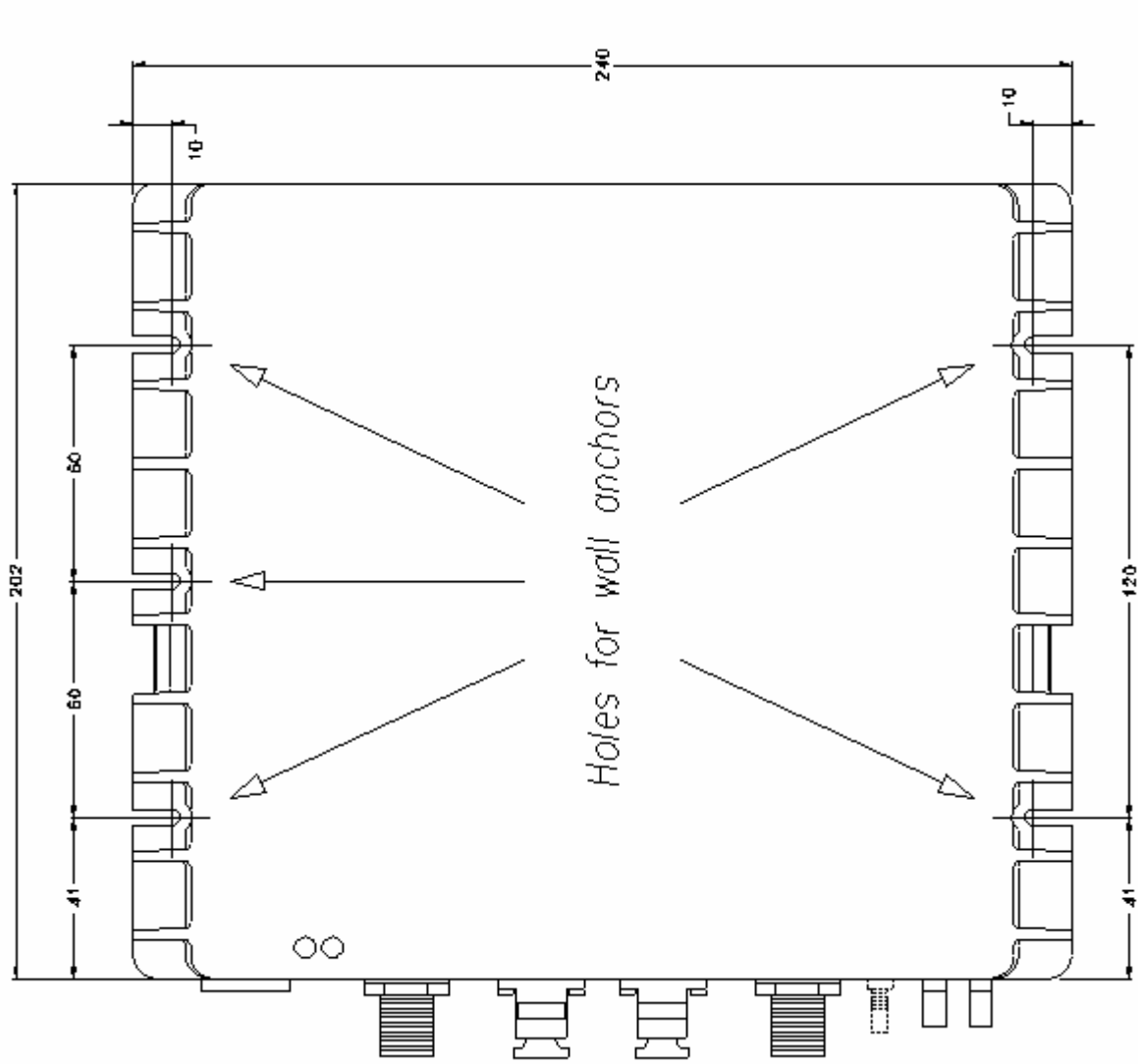


Fig. 3.45 (a): Layout of the TFBW booster, with wall anchor quotes

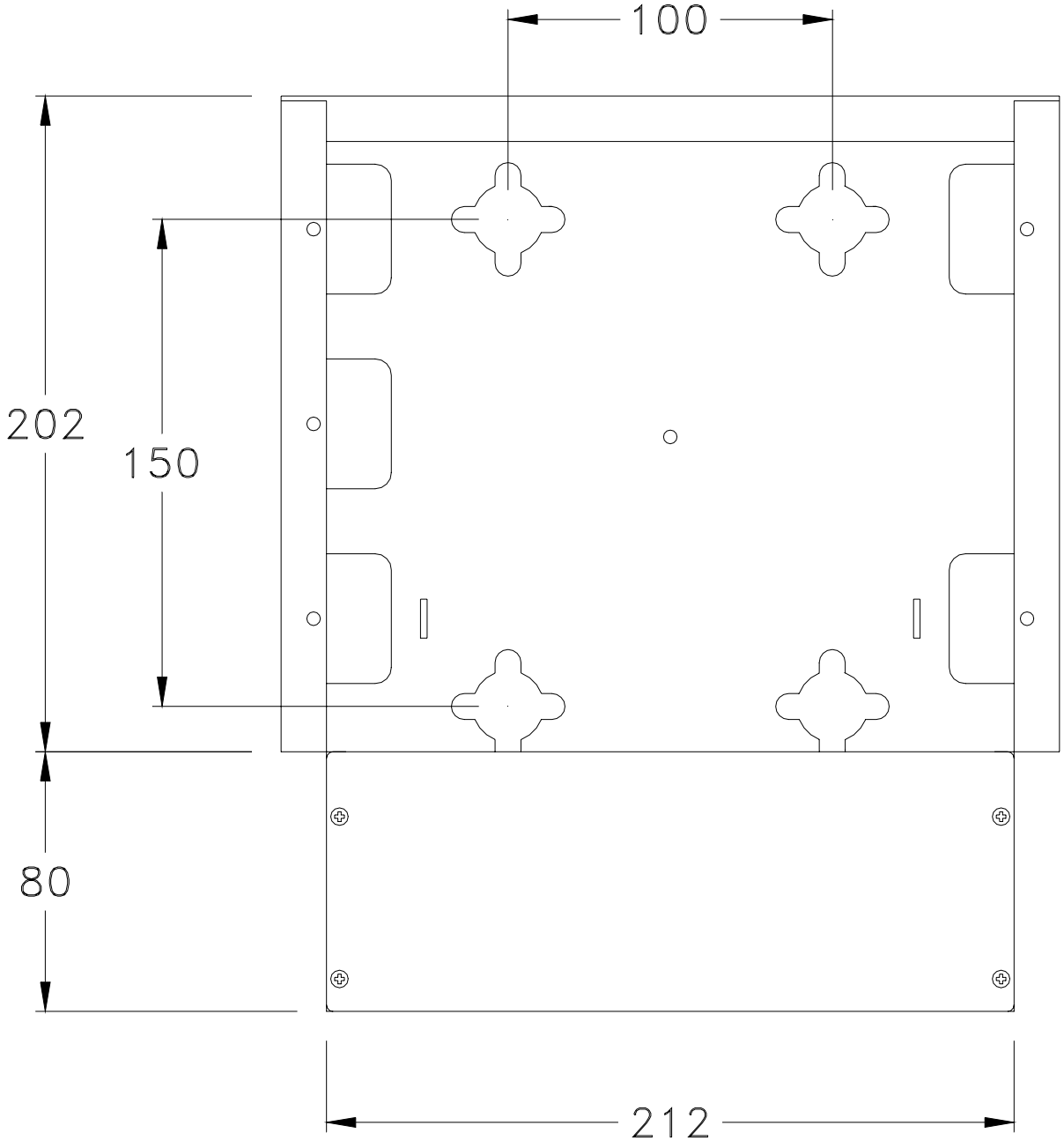


Fig. 3.45 (b): Layout of the TKA01 wall bearing, with wall anchor quotes

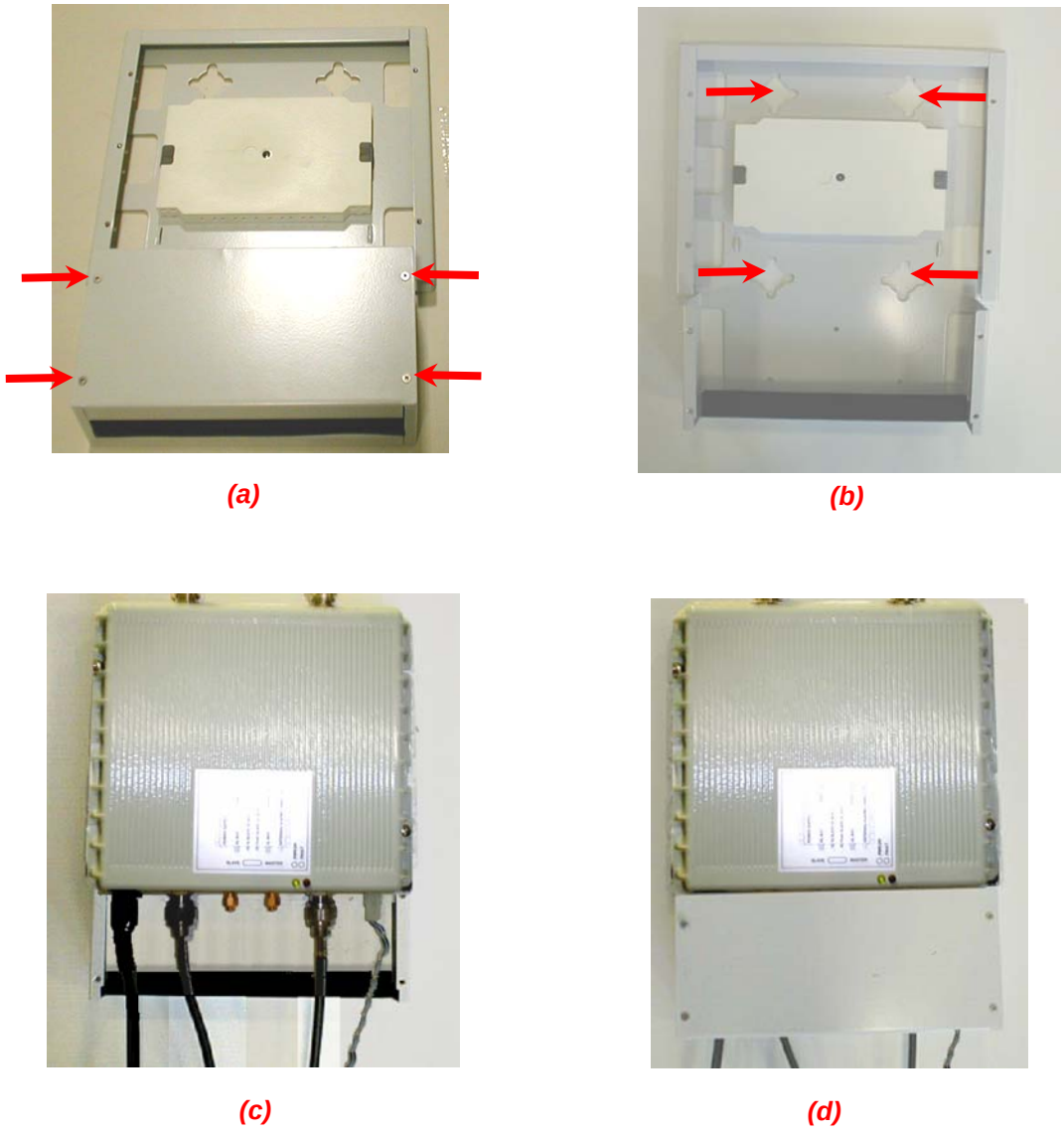


Fig. 3.46: Mounting the TFBW booster with a TKA01 installation kit.

4. Fast Master Unit

Module name:

Fast remote unit

TFLF

Main tasks carried out by the TFLF module

Downlink (DL):

- Power level adjustment (ALC)
- RF-to-optical conversion of the input RF signal
- Optical splitting: input RF signal is split onto 4 optical outputs

Uplink (UL):

- Uplink Gain adjustment (0 to 20dB, 5dB step)
- 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 path then they are filtered and duplexed into the RF port.

RF ports:

- 1 Duplexed DL/UL RF port

Note:
The maximum input levels at RF ports is +27dBm (please refer to datasheet for further information), as well as the UL path may require a power adjustment to fill within the BTS receiving range (use the built-in adjustable attenuator).

Optical ports

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

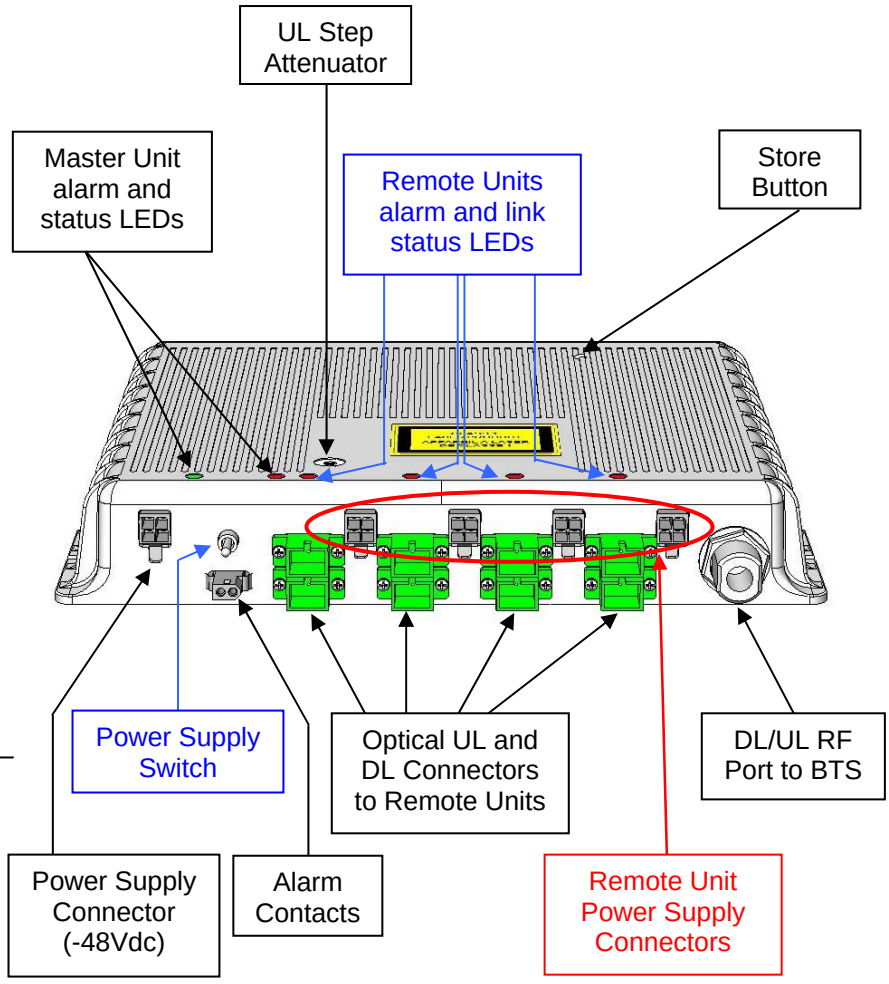


Fig. 4.1 Fast Remote Unit

Dimensions and Weight

Dimensions: mm 240 x 200 x 36
(inches 9.5 x 7.9 x 1.4)

Weight: please refer to *Britecell Plus Bulletin PA-100595EN* in order to know the updated data about the TFBW weight

TFLF visual alarms

The TFLF is provided with 6 LEDs (see on the right) showing status and alarm information.
LEDs meaning is reported on the rightward table.

Note: In case the four TFLF optical ports are not all connected to Remote Units, the unused ports must be properly masked, through the STORE button, at commissioning to avoid spurious alarms

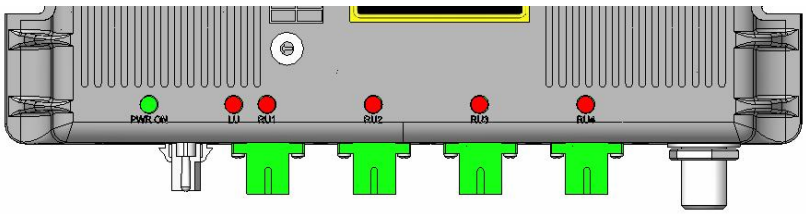


Fig. 4.2 The 6 LEDs on the warm side of the Fast Remote Unit

Label	LED colour	Meaning
PWR ON	Green	Power Supply status OK
LU	Red	General TFLF failure, it can be: - DL optical power fail - UL or DL amplifier failure - Temperature alarm
RU1	Red	From Remote Unit 1 it monitors: - UL or DL AGC out of range (flashing) - UL or DL optical power fail - DL amplifier failure - External alarm 1 - External alarm 2
RU2	Red	From Remote Unit 2 it monitors: - UL or DL AGC out of range (flashing) - UL or DL optical power fail - DL amplifier failure - External alarm 1 External alarm 2
RU3	Red	From Remote Unit 3 it monitors: - UL or DL AGC out of range (flashing) - UL or DL optical power fail - DL amplifier failure - External alarm 1 External alarm 2
RU4	Red	From Remote Unit 4 it monitors: - UL or DL AGC out of range (flashing) - UL or DL optical power fail - DL amplifier failure - External alarm 1 External alarm 2

Table 4.1: Summary of TFLF LED meaning

Dry contact alarms:

TFLF is also provided with dry contacts outputs (connectable through .062" MOLEX plugs) to report alarm condition to third party equipment (i.e. BTS or repeater).
The dry contact status is reported in the table rightwards.
Note: in case of power supply failure the system is not powered and the dry contacts will be automatically driven to a "closed" condition.

Alarm Condition	Contact Position
None	Open
Minor	Open
Major	Closed

Tab. 4.2: TFLF dry-contact meaning

UL Attenuation Adjustment:

The TFLF is designed to be compatible with most pico/micro BTSs. It is also provided with an internal adjustable attenuator for the UL path allowing 20dB attenuation range, 5dB step. Suggested settings are reported in the table 4.3.

Composite Input Power	External Attenuator	UL Adjustable Attenuator Setting
+37dBm	20dB (5W average)	0dB (Position nr. 0)
+33dBm	20dB (2W average)	0dB (Position nr. 0)
+24dBm	10dB	10dB (Position nr. 2)
+20dBm	5dB	15dB (Position nr. 3)
+14dBm	0dB	20dB (Position nr. 4)
+13dBm	0dB	20dB (Position nr. 4)

Tab. 4.3: TFLF UL attenuation suggested values

To adjust the value a flat screwdriver can be used as per the picture 4.2.

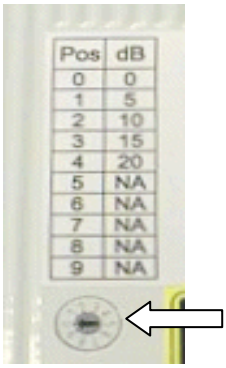


Fig. 4.3: Uplink Attenuator

TFLF power supply

Each TFLF Fast Master Unit requires -48Vdc power supply.

The power consumption of each TFLF is 10W.
An optional external adapter 220Vac to -48Vdc is available.

The TFLF also provide connections for the distribution of the -48Vdc to the Remote Units by means of composite cable. Each supply port is protected against overloads, short and surge with a self recovery fuse and surge protection. The power switch will disconnect the remote unit power supply in case of overcurrent.
The power consumption of each TFLF with 4 Remote Units is lower than 80W.

Warnings (to be read before the TFLF installation)

Dealing with optical output ports

- The TFLF Fast Master 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.

Handling optical connections

- When inserting an optical connector, take care to handle it so smoothly that the optical fibre is not damaged. Optical fibres have to be single-mode (SM) 9.5/125µm.
- Typically, Britecell Plus 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 radius of curvature less than 5 cm.
- 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 with a proper tissue before inserting each connector into the sleeve. In case adapter tips need to be better cleaned, use pure ethyl alcohol

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TFLF cautions

- The TFLF modules must be handled with care in order to avoid damage to electrostatic sensitive devices.
- Take care to meet expected requirements on RF ports. An external fixed attenuator could be necessary when the power coming from the BTS exceeds the required levels to avoid damages in circuitry or increase of spurious emissions.

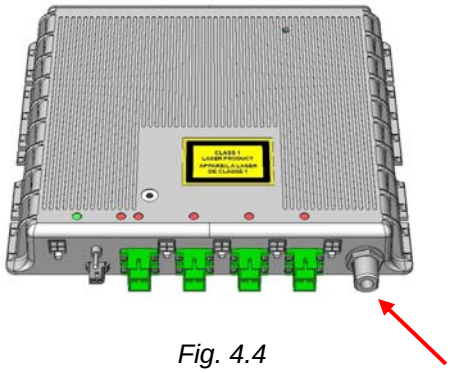
TFLF installation

First of all fix the Fast Master Unit to the wall by means of four screws (see fig. 4.5 for wall anchor quotes). Vertical position is suggested for ease thermal dissipation.

Fig. 4.4

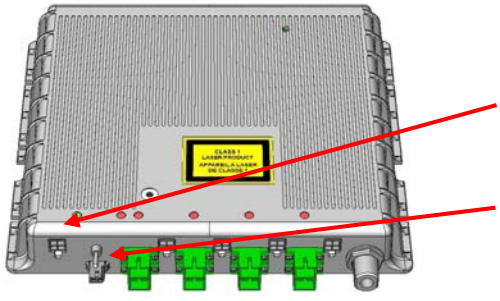
Verify that the composite cable has been laid and already properly connectorised. Two preconnectorised fibre optic cables and a power supply cable with 4-pole connector should be ready for connection to each Remote Unit and to each port of the TFLF.

Remove the caps from the optical connectors and connect the connectorised fibre optic cables to the optical ports of the unit. Then connect the previously connectorised copper cable to the proper power plug for each Remote Unit.



Verify the output power of the BTS or repeater which is going to be connected and check if external attenuation is required then set the UL attenuation through a flat screw driver (refer to the table reported in the relevant section)

Fig. 4.4



Apply the ferrite to the power supply cable.
Connect the provided patchcord to the -48Vdc power supply and insert the connector into the TFLF power plug.
Then switch one the unit by means of the ON/OFF power switch.
Note: if 220Vac power supply is available on site, use the suitable optional adapter.

Fig. 4.4

As you switch on the system, carefully refer to the TFLF Start-Up section.

TFLF start-up

Before the TFLF Master Unit is switched on, make sure that:
- every Remote Unit has been connected to relevant port of the Master Unit
- each remote unit has been connected to its coverage antennas

After that, remember that only when all the remote units are already on, the Master Unit itself can be turned on.
Once the Master Unit has been switched on, the following steps have to be followed:

1. Wait until the communication between TFLF and Remote Units is established and alarms related to unused ports arise.

2. Verify that all used ports don't have any active alarm. In case an alarm is present follow the troubleshooting procedure.

3. Press the STORE button for at least 5sec. (all TFLF LEDs will flash for 3sec.) in order to mask unused ports.

Removing the TFLF

Switch off the Master Unit power supply and remove the power cable. Remove the SC-APC optical connectors and insert the protection caps into TFLF optical ports. Then:
- unscrew the 4 screws and remove the unit
- put the removed TFLF unit in its safety box

TFLF troubleshooting

In case a TFLF Fast Master Unit has any problem, this will be easily revealed through LEDs which reveals not only failures of the TFLF itself but also malfunctions located on related remote units.

ALARM CODE (TSUN description)	*ALARM DESCRIPTION*	*ACTIVE LED*	*SUPERVISION PRIORITY LEVEL*	*ACTION RECOMMENDED*	*RELÉ PRIORITY LEVEL (subrack)*
DL optical power fail	TFLF DL optical power from the laser is too low	LU	MAJOR	Return the unit	CLOSED
DL RF alarm	DL RF amplifier	LU	MAJOR	Return the unit	CLOSED
UL RF alarm	UL RF amplifier	LU	MAJOR	Return the unit	CLOSED
Temperature alarm	Over-temperature alarm	LU (flashing)	MINOR	Check ventilation and environment	OPEN
Power supply alarm	Power supply fault	LU (PWR ON off)	MAJOR	Return the unit	CLOSED
UL1 optical power fail	TFLF UL1 optical power is too low	RU1	MAJOR	Check for fibre or splice stresses and	CLOSED

UL2 optical power fail	UL2 optical power is too low	RU2	MAJOR	clean the optical connectors. If the alarm still persists it reveals a laser fault so return the unit	CLOSED
UL3 optical power fail	UL3 optical power is too low	RU3	MAJOR		CLOSED
UL4 optical power fail	UL4 optical power is too low	RU4	MAJOR		CLOSED
DL1 optical power fail	DL1 optical power is too low	RU1	MAJOR	Check for fibre or splice stresses and clean the optical connectors. If alarm still persists it reveals a laser fault so return the unit	CLOSED
DL2 optical power fail	DL2 optical power is too low	RU2	MAJOR		CLOSED
DL3 optical power fail	DL3 optical power is too low	RU3	MAJOR		CLOSED
DL4 optical power fail	DL4 optical power is too low	RU4	MAJOR		CLOSED
UL1 AGC out of range	The optical power received on UL1 is too low and can't no more be compensated	RU1	MINOR (flashing)	Check for fibre or splice stresses and clean the optical connectors. If alarm still persists it reveals a laser fault so return the unit	OPEN
UL2 AGC out of range	The optical power received on UL2 is too low and can't no more be compensated	RU2	MINOR (flashing)		OPEN
UL3 AGC out of range	The optical power received on UL3 is too low and can't no more be compensated	RU3	MINOR (flashing)		OPEN
UL4 AGC out of range	The optical power received on UL4 is too low and can't no more be compensated	RU4	MINOR (flashing)		OPEN
DL1 AGC out of range	The optical power received on UL1 is too low and can't no more be compensated	RU1	MINOR (flashing)	Check for fibre or splice stresses and clean the optical connectors. If alarm still persists it reveals a laser fault so return the unit	OPEN
DL2 AGC out of range	The optical power received on UL2 is too low and can't no more be compensated	RU2	MINOR (flashing)		OPEN
DL3 AGC out of range	The optical power received on UL3 is too low and can't no more be compensated	RU3	MINOR (flashing)		OPEN
DL4 AGC out of range	The optical power received on UL4 is too low and can't no more be compensated	RU4	MINOR (flashing)		OPEN
DL1 RF alarm	DL1 RF amplifier	RU1	MAJOR	Return the unit	CLOSED
DL2 RF alarm	DL2 RF amplifier	RU2	MAJOR	Return the unit	CLOSED
DL3 RF alarm	DL3 RF amplifier	RU3	MAJOR	Return the unit	CLOSED
DL4 RF alarm	DL4 RF amplifier	RU4	MAJOR	Return the unit	CLOSED
RU1 External 1 alarm	External 1 alarm from RU1	RU1	MAJOR	Check the external device connected to external 1 and the RU1 dry-contact functionality	CLOSED
RU2 External 1 alarm	External 1 alarm from RU2	RU2	MAJOR	Check the external device connected to external 1 and the RU2 dry-contact functionality	CLOSED
RU3 External 1 alarm	External 1 alarm from RU3	RU3	MAJOR	Check the external device connected to external 1 and the RU3 dry-contact functionality	CLOSED
RU4 External 1 alarm	External 1 alarm from RU41	RU4	MAJOR	Check the external device connected to external 1 and the	CLOSED

				RU4 dry-contact functionality	
RU1 External 2 alarm	External 2 alarm from RU1	RU1	MAJOR	Check the external device connected to external 2 and the RU1 dry-contact functionality	CLOSED
RU2 External 2 alarm	External 21 alarm from RU2	RU2	MAJOR	Check the external device connected to external 2 and the RU2 dry-contact functionality	CLOSED
RU3 External 2 alarm	External 2 alarm from RU3	RU3	MAJOR	Check the external device connected to external 2 and the RU3 dry-contact functionality	CLOSED
RU4 External 2 alarm	External 2 alarm from RU41	RU4	MAJOR	Check the external device connected to external 2 and the RU4 dry-contact functionality	CLOSED

Tab. 4.4: TFLF alarm description

The previous table reports a brief description of the TFLF alarms, together with a reference to the corresponding alerted LEDs.
As the table shows, all major alarms are signalled also closing the dry contacts available on the TFLF allowing sending this information to any external equipment (i.e. BTS or repeater)

TFLF

One of the LEDs RU1, 2, 3, 4 might turn on not only to indicate a high optical loss detected by the TFLF, but also to reveal a remote unit failure. Understanding the reason why one of this LEDs 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 troubleshooting procedure is summarised by the flow-chart in fig. 4.7a)

1. In case the TFLF general alarm (LED LU) is on replace the faulty TFLF master unit with a new one and contact the manufacturer for assistance.
2. In case one of the LEDs RU1, 2, 3 or 4 is on, the corresponding TFLF adapter might be dirty. Try cleaning it using pure ethyl alcohol. If the LED is still on go to the corresponding remote unit side and check the red LED upon the 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. 4.7b).
    b. If it is on, refer to remote unit troubleshooting presented in the previous remote unit section

Fiber optic UL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 4.7b)

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 makes the TFLF LED switch off, troubleshooting has been successful. Otherwise, follow next steps.

2. Check if the SC-APC connectors are properly installed at both fibre ends (i.e. TFLF and TFAx ports). If not fix better SC-SPC connectors to relevant adapters. If this makes the TFLF LED switch off, troubleshooting has been successful. Otherwise, follow next steps.
3. Disconnect the optical fibre and clean it at both fibre ends (i.e. TFLF side and TFAx side) then reconnect the fibre to relevant ports. In case this makes the TFLF LED switch off, troubleshooting has been successful. Otherwise, follow next steps.
4. Disconnect the optical SC-APC connector from TFLF UL port, and measure the output power P_{OUT}(UL) at 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 cable path is too long. Replace it.
    b. If A_{UL} < 4dB, then TFAx remote unit should be faulty. Before replacing it, contact for assistance

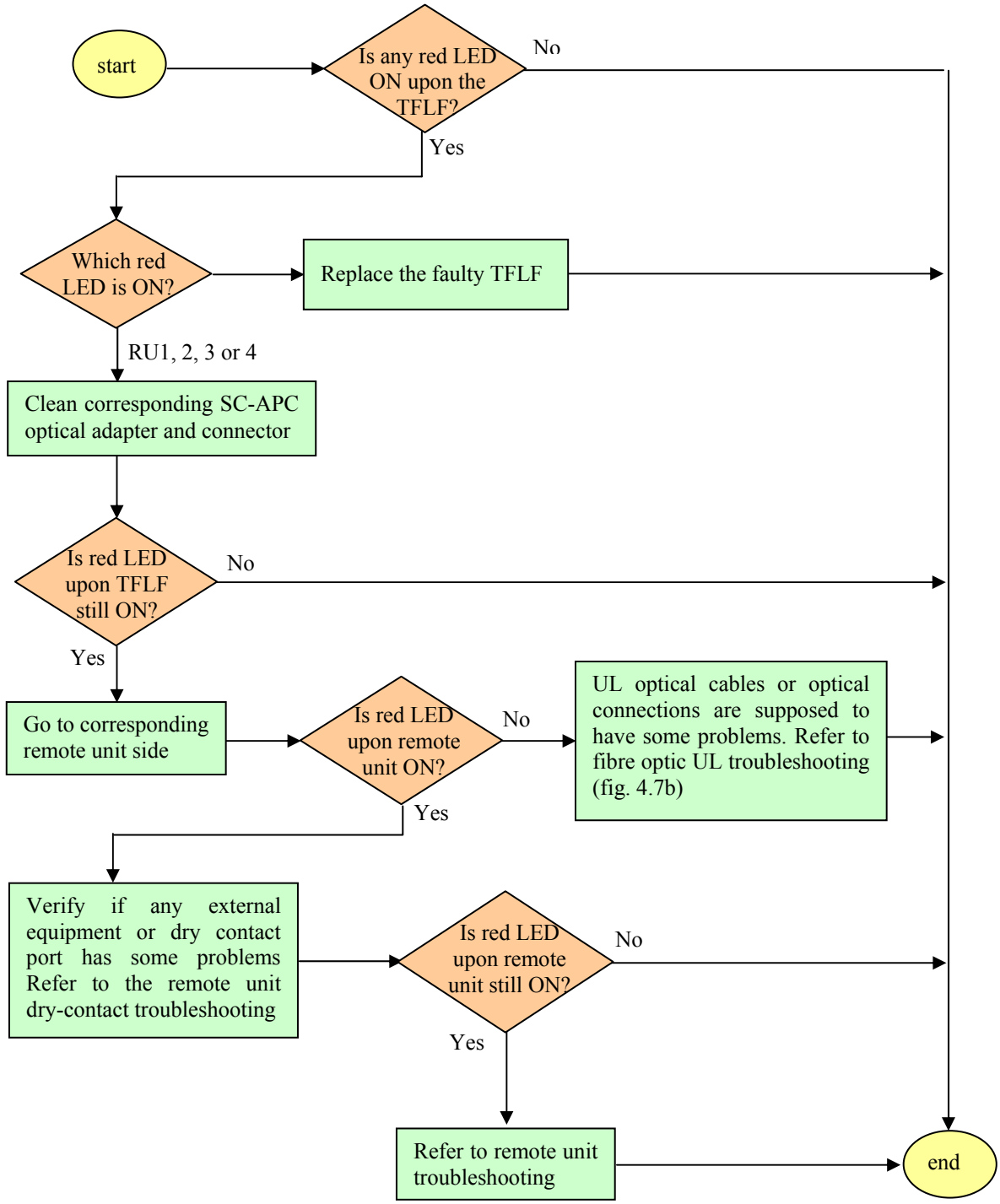


Fig. 4.7 (a): Flow-chart describing the quick troubleshooting procedure

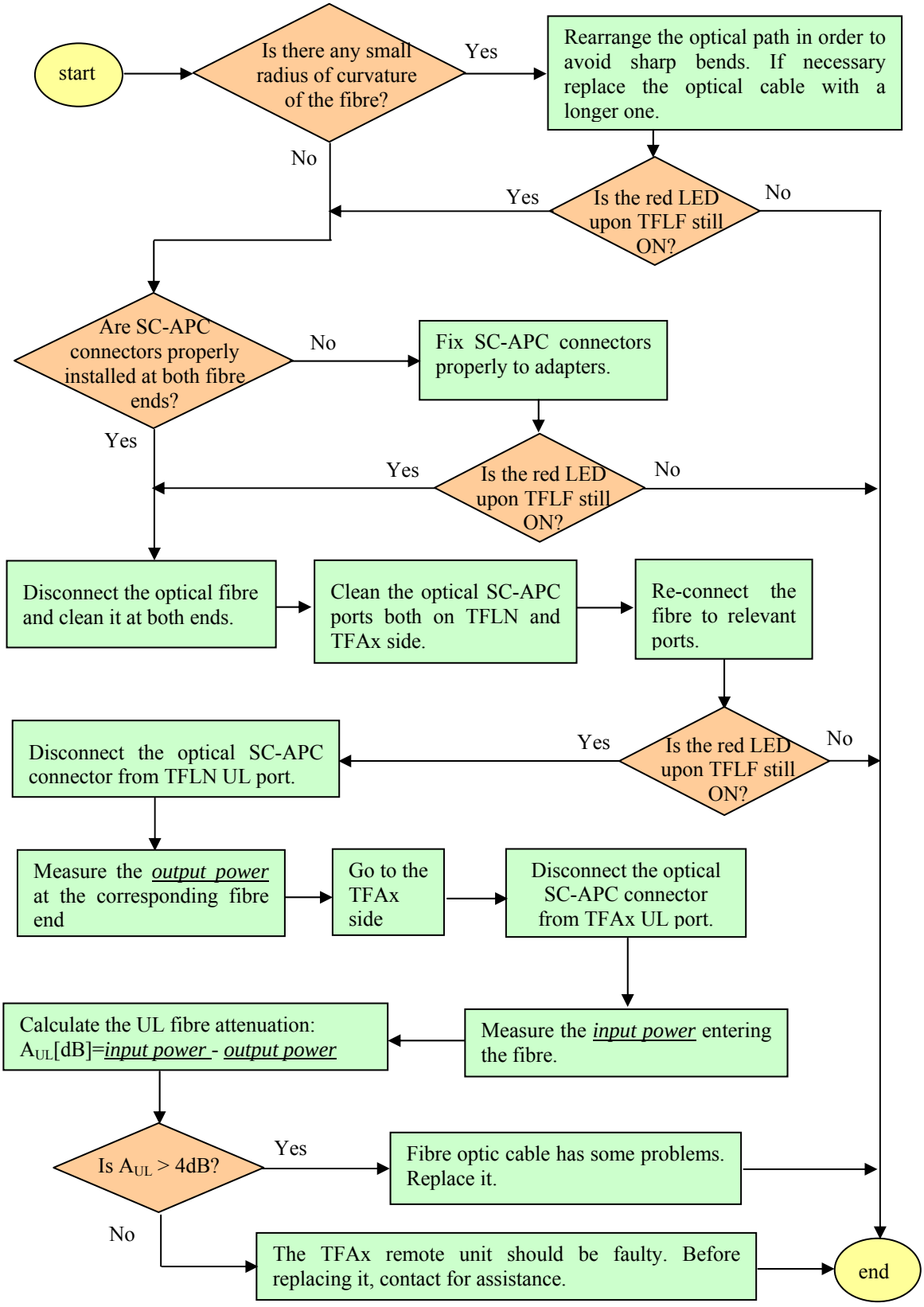


Fig. 4.7 (b): Flow-chart describing the fibre optic UL troubleshooting