BRITECELL PLUS

User Manual

MN024-04

Tekmar Sistemi Srl
An Andrew Company

Via De Crescenzi 40
48018 Faenza RA
Tel: (+39) 0546 697111
Fax: (+39) 0546 682768
www.andrew.com

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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 Britecell Plus brief Description

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 400 MHz- 2500 MHz 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 (TFAxxx), 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 TFAxxx.

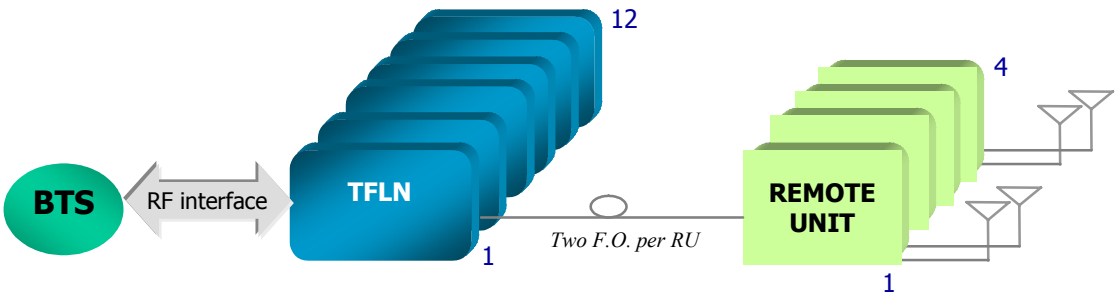


Fig. 1: Britecell Plus system block diagram.

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, a special option 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 extremely 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 (- 48) 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, multi-band duplexer/triplexer, attenuators, couplers for UL/DL paths, thus allowing the maximum design flexibility
- **high reliability**: the MTBF (Mean Time Between Failure) is estimated to be 300000 hours.

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.

1.5 Health and Safety Warnings

IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, the following antenna installation and device operating configurations must be satisfied: A separation distance of at least 35 cm must be maintained between the antenna of this device and all persons. RF exposure compliance may need to be addressed at the time of licensing, as required by the responsible FCC

Bureau(s), including antenna co-location requirements of 1.1307(b)(3). Maximum permissible antenna gain is:

Britecell Plus TFAM Remotes: 10dBi.

1.6 Britecell Plus Operation with Multiple RF Channels

The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.

2. Equipment Overview

2.1. The Remote Unit TFAxxx and relevant TKA installation kit

The TFAxxx is a device providing optical-to-electrical downlink conversion and electrical-to-optical uplink conversion, thus allowing a bidirectional transmission of signals between one TFLN and the remote antennas. It is available in 3 versions (low-power, medium-power, and high-power), each designed in order to support different output power levels on RF antenna ports.

Fig. 2: Different Remote Unit cases

In downlink each TFAxxx receives an optical signal from the TFLN, 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 TFLN over the optical fibres.

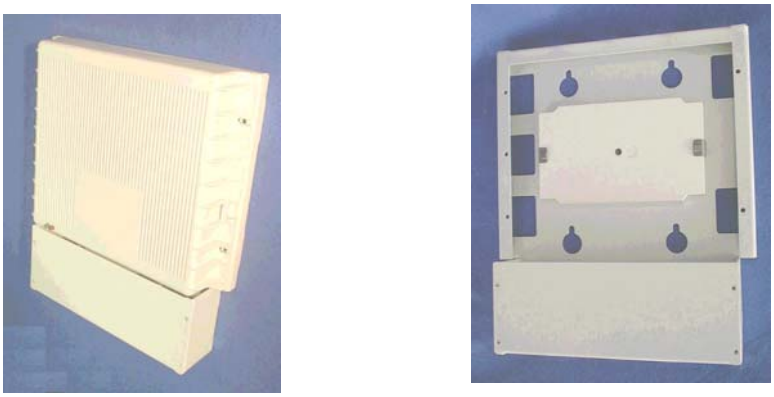


Fig. 3: TKA mounting kit for low and medium power remote units

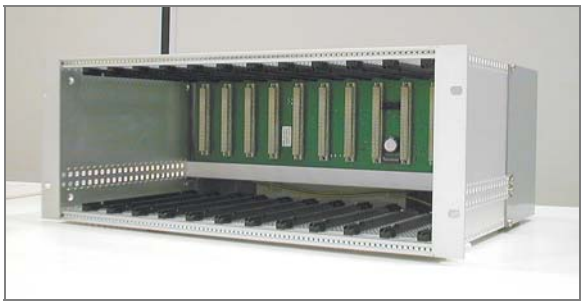
Each TFAxxx can be provided with an optional TKA installation kit, which contains a fibre optics splice holder and a compact case for an easy installation of the TFAxxx on walls or poles.

Moreover, the TKA compact cases are able to provide the TFAxxx with the different IP protection levels, depending on the specific environmental requirements.

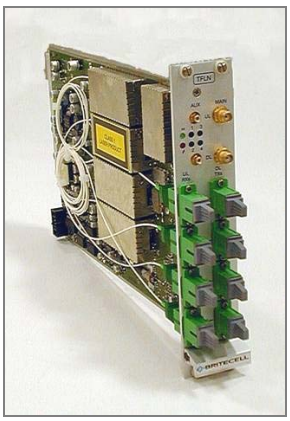
2.2. The Britecell Plus Master Unit

Below are listed the Britecell Plus modules. For further details about these components, refer to the next chapters of this manual.

The Sub-rack (TPRN) is a 19" subrack hosting the Britecell Plus modules; it accommodates 12 slots, whose sizes are 7 TE x 4 HE. 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.



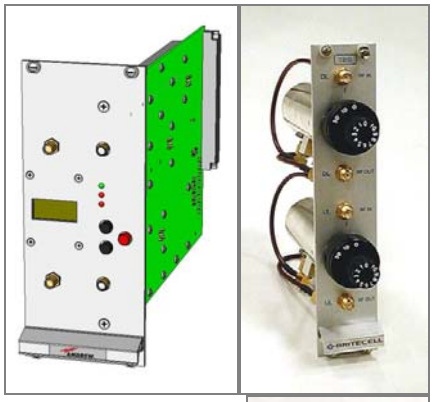
The Local Unit (TFLN): in downlink it provides an RF-to-optical conversion of the signal coming from the BTS, and transmits it to 4 optical outputs, so as to feed 4 TFAxxx. In uplink it provides optical-to-RF conversion for 4 optical signals coming from RUs, and it combines them into a single RF output,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



The duplexer (THYN): 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.

The variable RF attenuators (TBSI and TDI): they provide independent attenuations (adjustable from 0 to 30dB, with 1dB steps) on uplink and downlink RF paths, and allow the designer to optimize the signal level close to the BTSs. TBSI is an override attenuator, while TDI is a digital attenuator also providing 20dB gain on the UL path. Their dimensions are:

TBSI: Width = 7TE, Height = 4HE, i.e. a 1-slot space
TDI: Width =14TE, Height= 4HE, i.e. a 2-slot space



The RF diplexer (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: Width = 7 TE, Height = 4 HE (one slot).

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

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 LUs. In uplink the TLCN2 (or TLCN4) combines 2 (4) RF signals coming from different LUs 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 Local Units;
- To connect several BTSs to a LU. In downlink the TLCN2 (TLCN4) combines the RF signals coming from different BTSs onto a common RF signal, entering the LU.

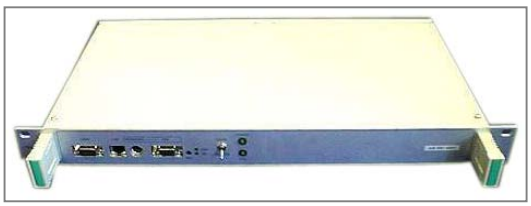
In uplink TLCN2 (TLCN4) splits the composite RF signal coming from a LU into 2 (4) RF signals entering different BTSs.

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

The wideband amplifier (TWANxx): it is an amplifier used to interface low power base stations to Britecell system. Its purpose is to amplify both DL and UL signals in order to compensate losses of passive combiners and splitters. Dimensions: Width = 7 TE, Height = 4HE.

The power limiters (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.

The SNMP agent (TSUNx): it is able to control up to 14 master units. It is available both as a plug-in module (Width = 14 TE, Height = 4HE, 2 slots) and as stand alone device (Width= 19", Height=1HE). It consists in a CPU, a flash memory and an Interface Board.



2.3. Block diagrams

To better understand the functions of the different units and modules, two block diagrams of the Britecell Plus system are reported here.

The first diagram (Fig. 4) refers to the case of duplexed BTSs, ie. BTS conveying both the downlink and uplink signals on a single RF port. In this case, a THYN module is required to combine the uplink and downlink paths on a single RF port. The second diagram (Fig. 5) refers to the case of not-duplexed BTSs, ie BTSs conveying the uplink and the downlink connections on separate RF ports.

Table 2.1 shows an overview of Britecell Plus equipment, including all the modules and the units stated above.

For more information about the single units and/or the single modules, please refer to the following sections.

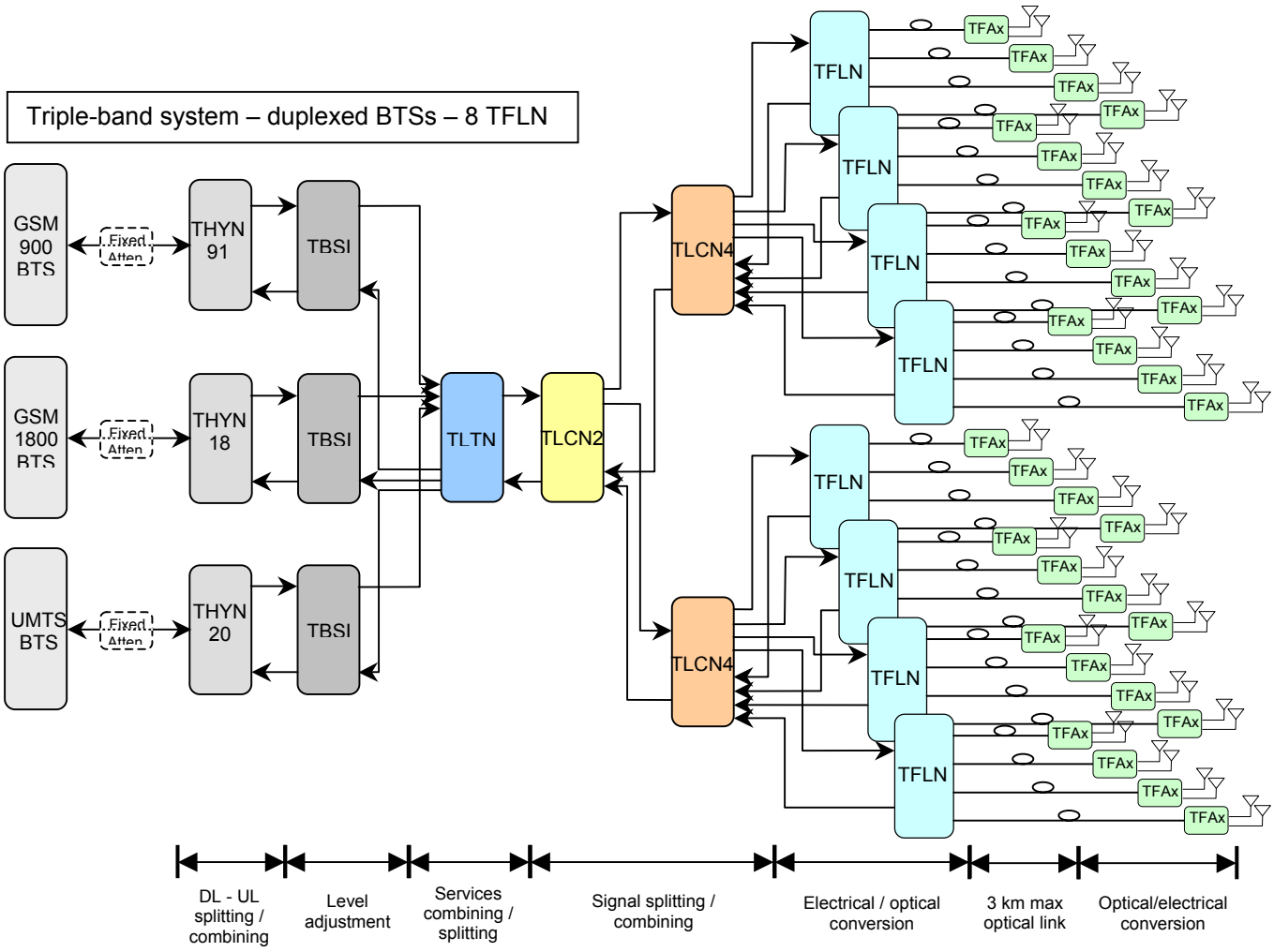


Fig. 4: Block diagram for a triple band system with 8 TFLN fully populated of TFAxxx, and duplexed base stations.

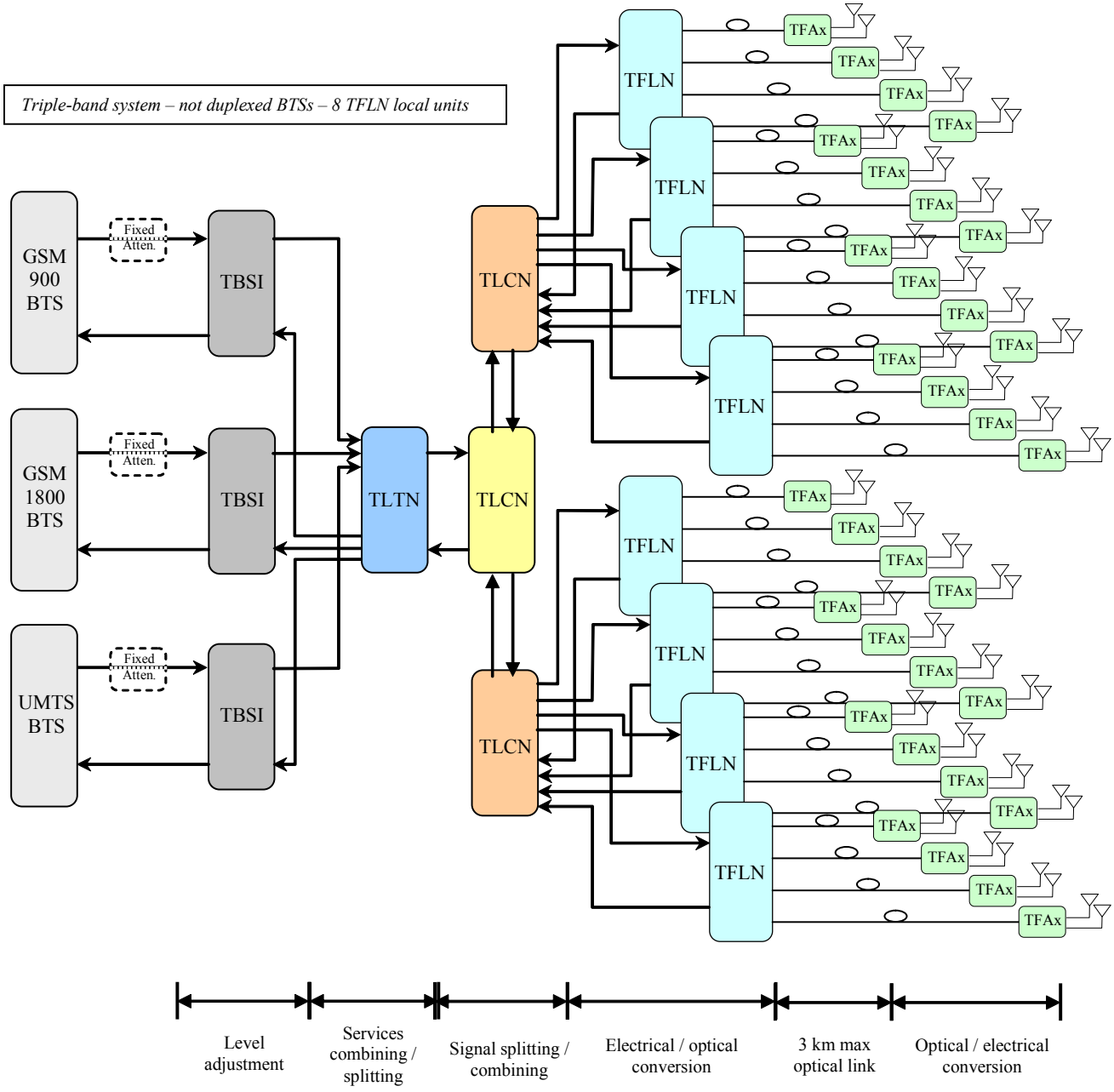


Fig. 5: block diagram for a triple band system with 8 TFLN fully populated, and non-duplexed base stations.

Unit or Module name	Description	Dimensions
TFAxxx case-A TFAxxx case-B TFAxxx case-F TKA01 TKA02 TKA04	Remote unit Remote unit Remote unit RU installation kit RU installation kit RU installation kit	240 x 200 x 38 240 x 240 x 38 445 x 255 x 167 280 x 240 x 55 305 x 270 x 58 340 x 240 x 55
TPRN04 TPRNx4 TFLNx TLCN2/4 TBSI2-30 TDI2-30 THYNx TLDNx TLTNx TMPx-10 TWLI	passive subrack active subrack Local unit 2/4-way splitter adjustable attenuator digital adjustable attenuator UL/DL duplexer diplexer triplexer 10 dB power limiter WLAN interface	19” x 4HE 19” x 4HE 7TE x 4HE 7TE x 4HE 7TE x 4HE 14TEx4HE 7TE x 4HE 7TE x 4HE 7TE x 4HE 7TE x 4HE 14TE x 4HE
TFBW TSUN1 or TSUN3 TSUN6	WLAN booster SNMP agent standalone SNMP agent plug in	240 x 200 x 38 19” x 1HE 14TE x 4HE

Tab. 1: Overview of all Britecell Plus available modules and units

3. Remote Unit TFAxxx

Module name:
Remote Unit TFAxxx

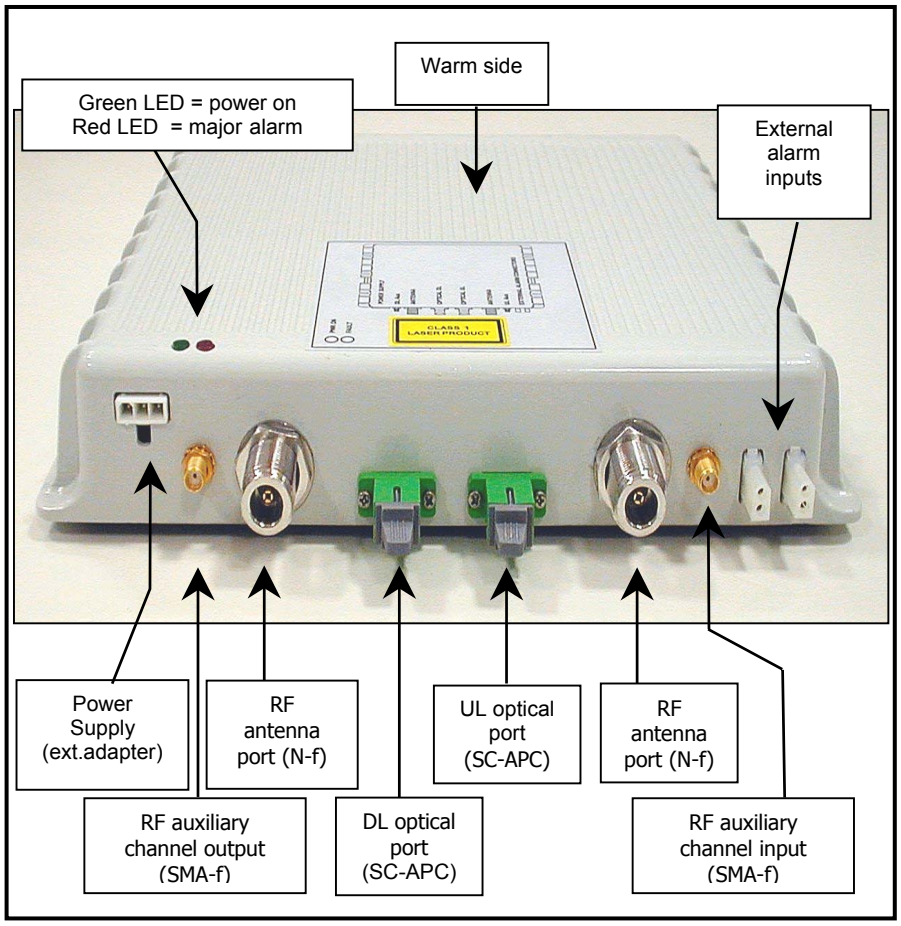
Case A

Main processes carried out by the TFAxxx:

- In Downlink (DL) operations:
  - Optical-to-RF conversion of the input optical signal
  - Automatic Gain Control (AGC) of each converted signal, in order to compensate optical losses (provided they are < 4dB);
  - 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 which lie out of the Downlink band
  - RF duplexing and splitting: the boosted RF signal is conveyed to 2 antenna ports
- In Uplink (UL) operations:
  - 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 which lie out of the Uplink band
  - Automatic Level Control (ALC): the RF signal level is adjusted according to the blocking requirements
  - RF-to-optical conversion of the signal, which is finally conveyed to the output optical port.

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 distributed antennas either directly (i.e. through RF jumper cables) or through external TLCN passive splitters, thus allowing more antennas to be fed. **Unused RF ports are to be terminated with a 50 Ω load.**
- 1 RF auxiliary input and 1 auxiliary output (designed to receive and transmit additional signals like WLAN by means of proper booster TWBA). Auxiliary input and output ports are SMA-female connectors.



Optical ports:

- 1 optical output port, transmitting UL signals to TFLN local unit
- 1 optical input port, receiving DL signals from TFLN local unit

Module name:
Remote Unit TFAxxx

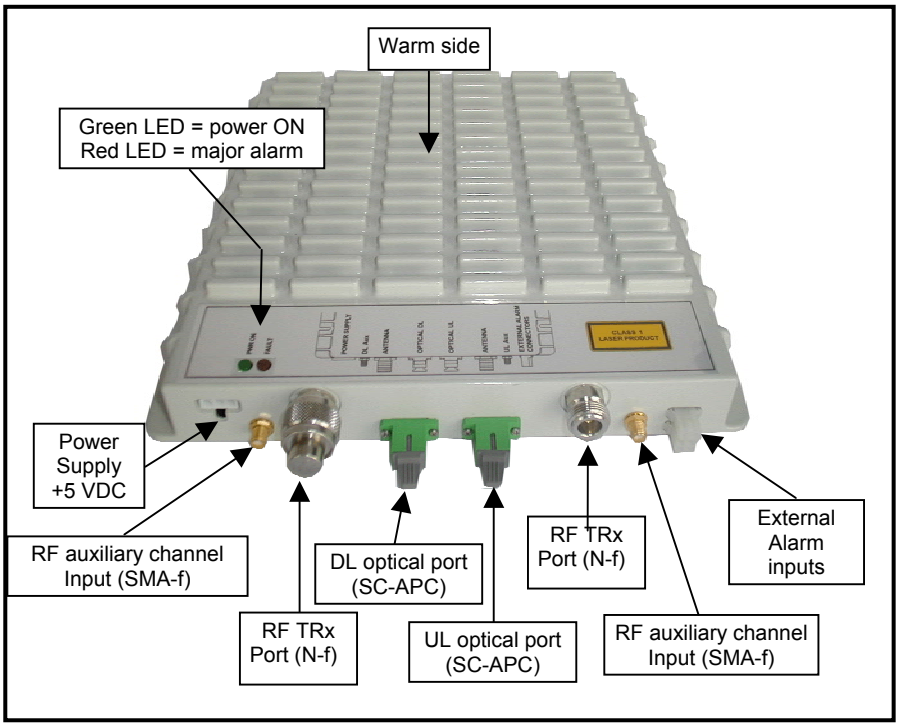
Case B

Main processes carried out by the TFAxxx:

- In Downlink (DL) operations:
  - Optical-to-RF conversion of the input optical signal
  - Automatic Gain Control (AGC) of each converted signal, in order to compensate optical losses (provided they are < 4dB);
  - 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 which lie out of the Downlink band
  - RF duplexing and splitting: the boosted RF signal is conveyed to 2 antenna ports
- In Uplink (UL) operations:
  - 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 which lie out of the Uplink band
  - Automatic Level Control (ALC): the RF signal level is adjusted according to the blocking requirements
  - RF-to-optical conversion of the signal, which is finally conveyed to the output optical port.

RF ports:

- 2 RF antenna ports,



means of proper booster TWBA). Auxiliary input and output ports are SMA-female connectors.

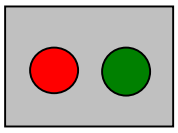
Optical ports:

- 1 optical output port, transmitting UL signals to TFLN local unit
- 1 optical input port, receiving DL signals from TFLN local unit

Visual alarms:

Two control LEDs are provided on the TFAxxx front side.
The green LED describes the power supply status, while the red LED describes the major Remote Unit failures.

TFAxxx LED

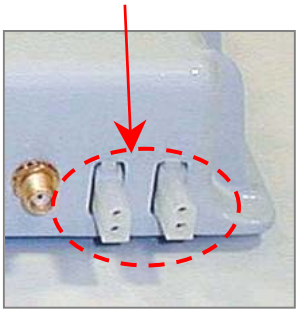


Led colour	*Meaning*
Red	Low optical power at DL input and/or RF amplifier failure
Green	Power supply status

Dry contact alarms:

TFAxxx is provided with two dry contacts inputs, which can be connected (through .062" MOLEX plugs) to any external device (ie. the TFBW stated above.

dry contacts



Dry contacts are open under non-alarm condition

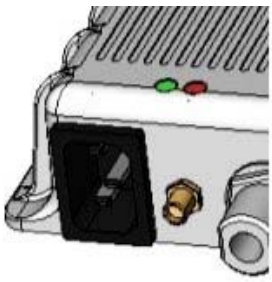
Power supply:

TFAxxx can be powered by universal mains (85/265 Vac) and by negative supply (-72/-36 Vdc).
Power supply adapter is included in the remote unit and can be external or internal according to the different models and part numbers:

- Case A: internal for all models with only exception of TFAN20 that has external adapter
- Case B: always external adapter for all models

Case A Remote Unit (except TFAN20)

These Remote Units are provided with internal power supply both for the 220VAC option and for the -48VDC option. As shown in the figure below different power supply connectors are provided for the two versions:

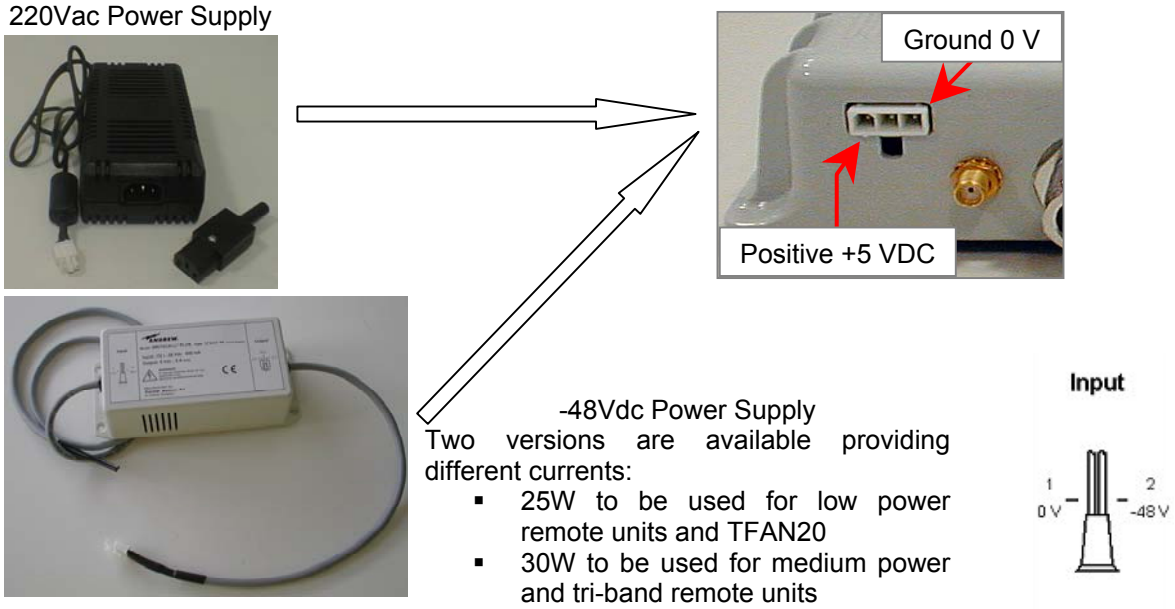


220VAC version
(IEC connector)

-48VDC version
(4 poles connector)

Case B Remote Unit and TFAN20

These Remote Units are provided with external power supply both for the 220VAC option and for the -48VDC option. As shown in the figure below different power supply are provided for the different versions each one providing to the remote units the +5VDC power supply through a 3 poles



Warnings (to be read before remote units are installed)

Dealing with optical output ports

The TFAxxx 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

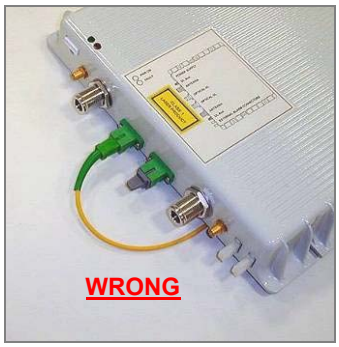
1. TFAxxx Remote Units are to be installed as close as possible to the radiating antennas, in order to minimize coaxial cable length, thus reducing the downlink power losses and the uplink noise figure.

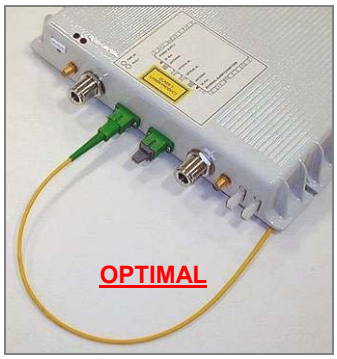
- When positioning the TFAxxx remote unit, consider that the placing of the relating antennas should be decided in order to minimize the Minimum Coupling Loss (MLC), so as to avoid blocking
- The TFAxxx remote unit is intended to be fixed on walls, false ceilings or other flat vertical surfaces (TKA installation kits are available, in order to provide a protective cover for TFAxxx Remote Unit, while making the TFAxxx 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 5 cm. 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.





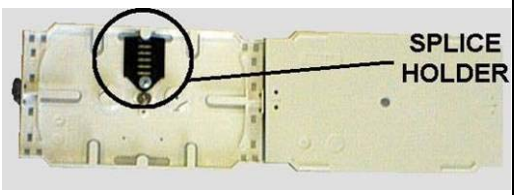
TFAxxx installation instructions

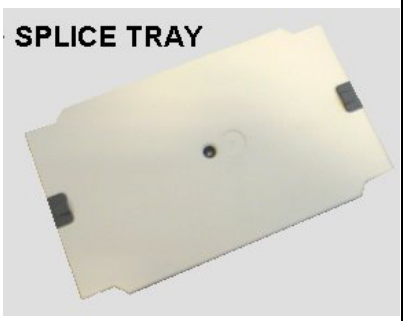
The TFAxxx kit includes:
A. 1 remote unit TFAxxx
B. a 50 Ω load
and according to the chosen model
C. an external power supply adapter (85-264 Vac or -48 V_{DC})
D. mains plug or -48 plug

First, 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. 6, 7.
Fix the TFAxxx remote unit to the wall by firmly screwing the anchors.

In case you have purchased a TKA installation kit so as to preserve your TFAxxx remote unit, a splice holder is provided with the kit:

1. Fix the splice holder inside the splice tray.
2. Splice the optical fibres and close the splice tray.
3. Take care not to bend the fibres too much.
4. Fix the splice tray inside the splice box.





Note:
If you use your own splice box fix the splice box beside the TFAxxx

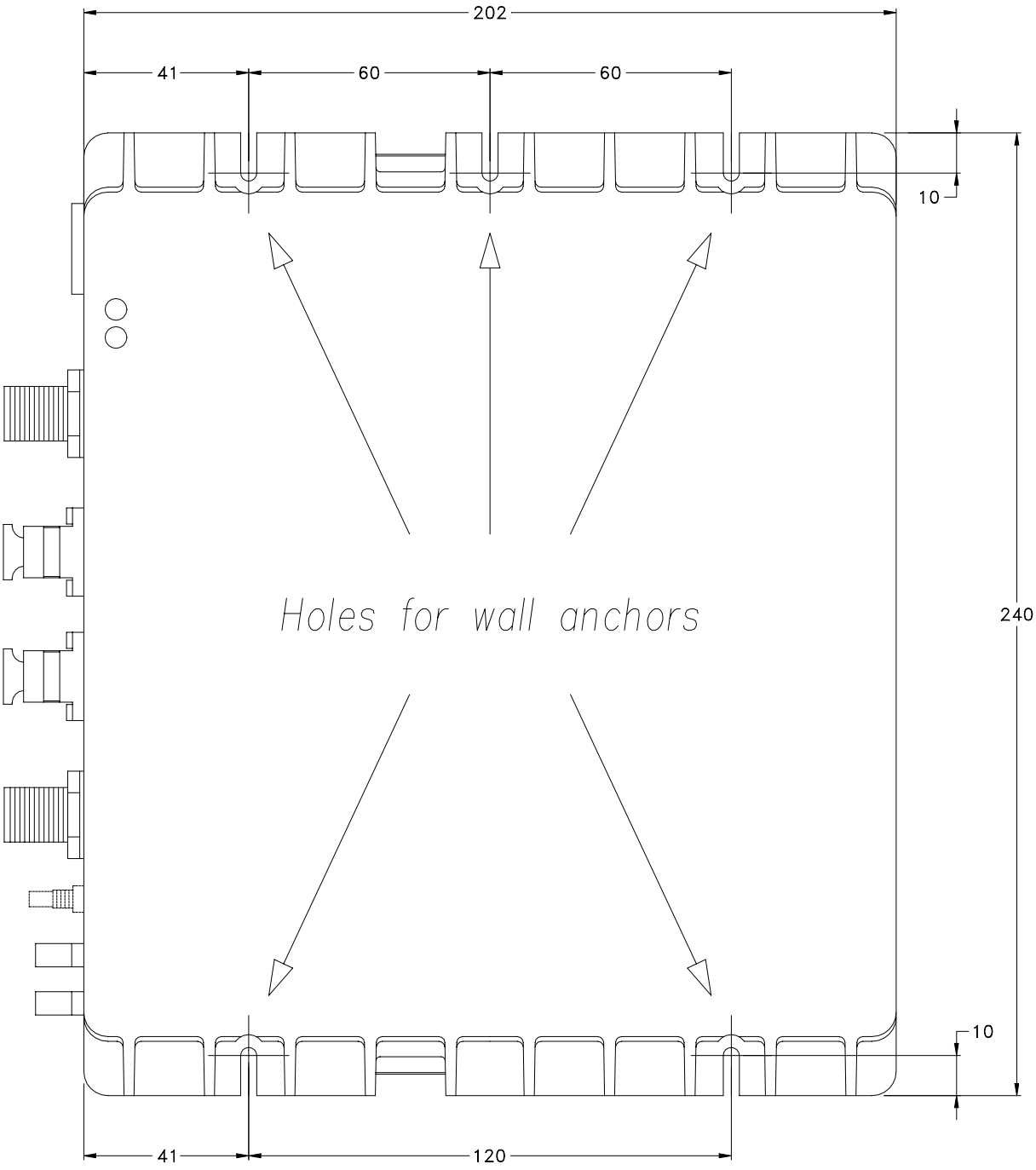


Fig. 6: CASE A layout with quote for wall anchors

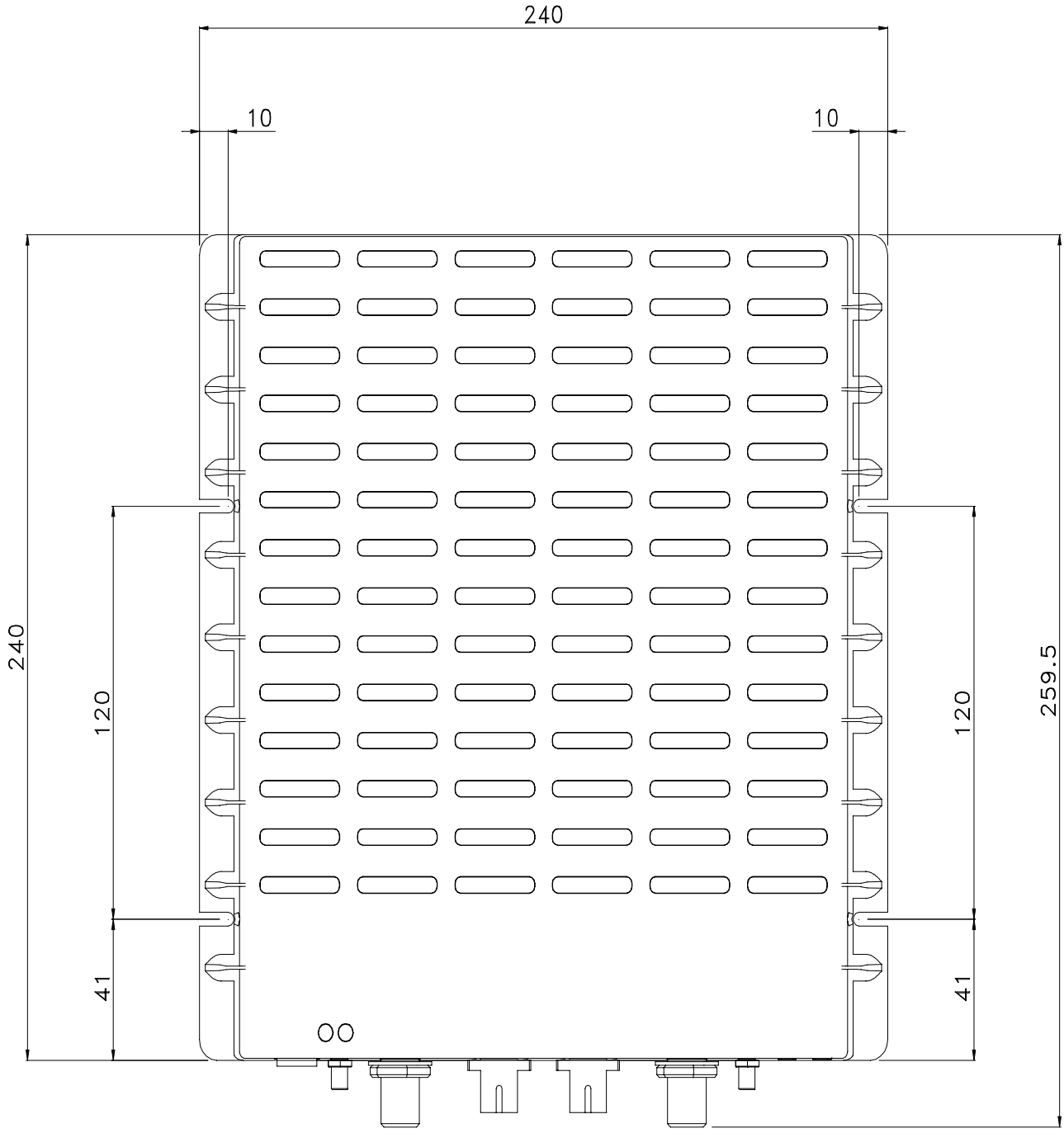


Fig. 7: CASE B layout with quote for wall anchors