22. Introduction

This section describes the TPR family (19” Sub rack). The TPR is part of the Britecell system and host all plug-in modules such as TFL-card, TLC splitter/combiner, TFL-BSI Base Station Interface and control modules.

A TPR sub-rack, when fully equipped, can support up to 6 TFL Local Units, one 2-way splitter-combiner, two 3-way splitter-combiners, one Base Station Interface, and one control module. Therefore this complete configuration supports up to 24 TFA Remote Units and up to 48 antennas.

23. Part description

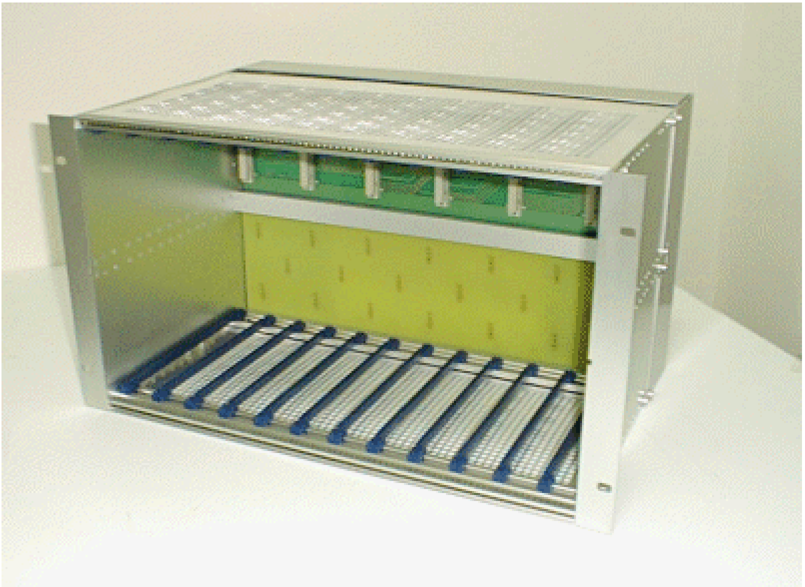


Fig. 22 TPR912

24. Warnings

Local interfaces may not be placed next to each other; one 7te module is always required between them.

TFL local interface cards can only be fitted in slots 1, 3, 5, 7, 9, and 11 of the sub-rack, slot 1 being the left most one.

- ✓ *WARNING: any slot capable of accepting an TFL that is unused must be fitted with a dummy plug to avoid alarms being generated (see Fig. 23)*
- ✓ *WARNING: do not remove or insert any module into TPR subrack, without switching the power supply off.*

Fig. 23 - Dummy connector

25. Functional description

The TPR subrack provides:

- power supply to the active plug-in cards (12VDC);
- alarm logic and relays;
- mechanical housing and positioning.

25.1. Block diagram

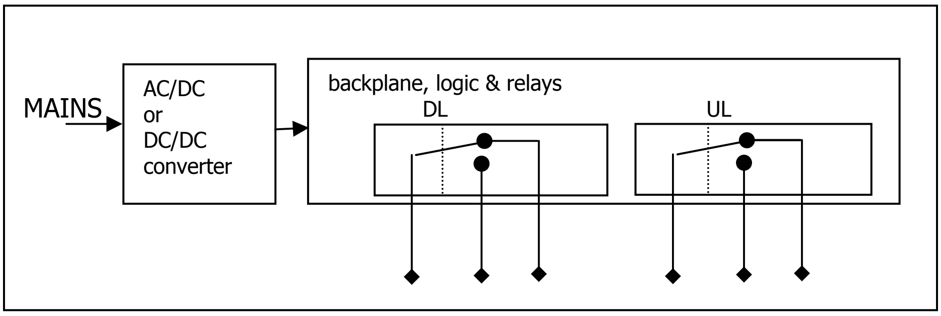


Fig. 24 – TPR block diagram

26. Alarms

The TPR sub-rack has a built-in alarm circuit: any fault in TFL or TFA causes a contact relay close or open.

A sub-D 9 pins male connector at the back of the sub-rack gathers summary and specific alarms of master/local subrack (see Tab. 6)

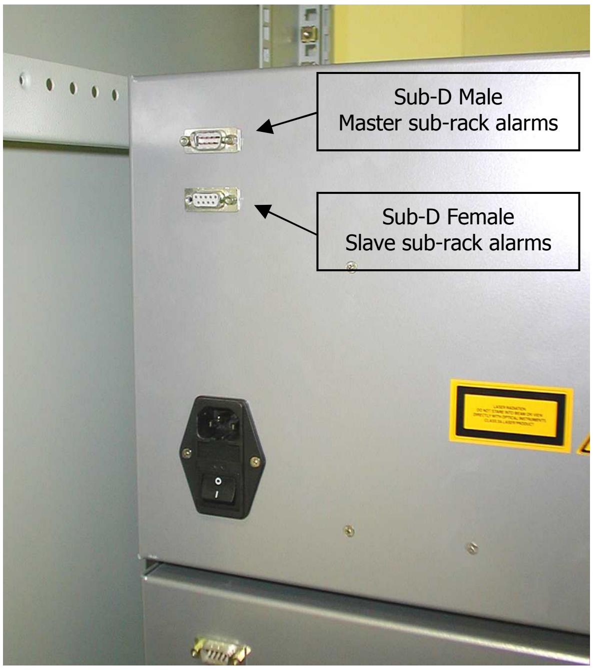
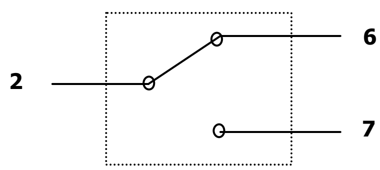
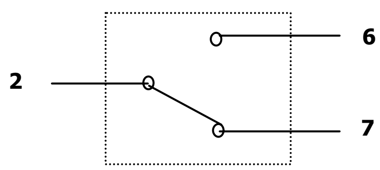
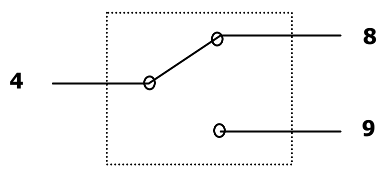
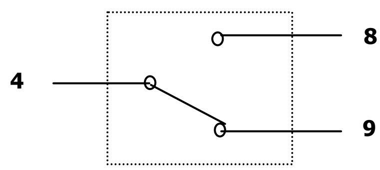


Fig. 25 alarm relay connector

Master/Local Sub-rack Alarm status (SUB-D Male)

PIN	*Name*	*Meaning*	*Description*
1	not connected		
2	DL Summary Alarm	Common contact	
3	not connected		
4	UL Summary Alarm	Common contact	
5	not connected		
6	DL Summary Alarm	To choose in conjunction with PIN 2, Normally Closed	2 - 6 = Open circuit if Local Sub rack Downlink is in alarm
7	DL Summary Alarm	To choose in conjunction with PIN 2, Normally Open	2 – 7 = Short circuit if Local Sub rack Downlink is in alarm
8	UL Summary Alarm	To choose in conjunction with PIN 4, Normally Closed	4 - 8 = Open circuit if Local Sub rack Uplink is in alarm
9	UL Summary Alarm	To choose in conjunction with PIN 4, Normally Open	4 – 9 = Short circuit if Local Sub rack Uplink is in alarm

Tab. 6 Master sub-rack alarm connector pinout

	normal condition (no alarm)	**Alarm Condition**
Down Link		
Up Link		

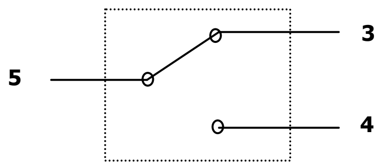
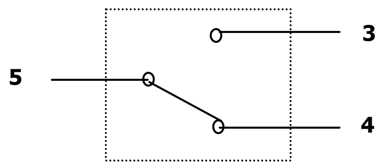
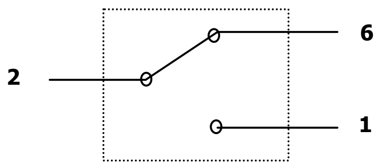
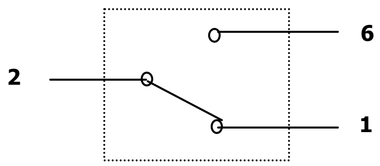
If a slave sub-rack is connected via TSU012 Control Unit or TFLB Interconnect Link Unit, alarms from slave/remote sub rack are also reported through the TPR back plane at the auxiliary DB9 female connector, providing alarm relay logic similar to the master (see Tab. 7)

NOTE: TPR subrack provides connections for more detailed alarms, at the right most slots (see TSU012 control unit product specification)

Slave/Remote Sub-rack Alarm status (SUB-D Female)

PIN	***Name***	***Meaning***	***Description***
1	UL Summary Alarm	To choose in conjunction with PIN 2, Normally Open	2 – 1 =Short circuit if Remote Sub rack Uplink is in alarm
2	UL Summary Alarm	Common contact	
3	DL Summary Alarm	To choose in conjunction with PIN 5, Normally Closed	5 - 3 =Open circuit if Remote Sub rack Downlink is in alarm
4	DL Summary Alarm	To choose in conjunction with PIN 5, Normally Open	5 – 4 =Short circuit if Remote Sub rack Downlink is in alarm
5	DL Summary Alarm	Common contact	
6	UL Summary Alarm	To choose in conjunction with PIN 2, Normally Closed	2 - 6 =Open circuit if Remote Sub rack Uplink is in alarm
7	not connected		
8	not connected		
9	not connected		

Tab. 7 Slave sub-rack alarm connector pinout

	Normal Condition (no alarm)	**Alarm Condition**
Down Link		
Up Link		

27. Installation and cabling

27.1. Location

The TPR sub-rack should be placed as near as possible the BTS or the RF repeater. The sub-rack location should be easy to reach by the users in order to allow alarm monitoring.

- ✓ *WARNING! do not close the air circulation subrack grids (top and bottom) with panels or obstacles.*
- ✓ *If the subrack mounting location does not have a good air circulation, leave at least one unit (1HE) free between subracks.*

27.2. Power supply

The connection to the mains has to be carried out following all the necessary precautions, including the following:

- in accordance with diligence rules (ex. CEI rules, IEC rules, etc.);
- in accordance with the rules for the safety against direct or indirect contacts;
- in accordance with the rules for the safety against over current (short circuit, overloading);
- in accordance with the rules for the safety against the over tension;
- the connection is to be carried out by properly trained technicians.

27.2.1. Universal mains

Universal main (85-264VAC, 50/60Hz) apply to TPR912 model only. Mains connector is placed on the back panel (see Fig. 26 mains connector)

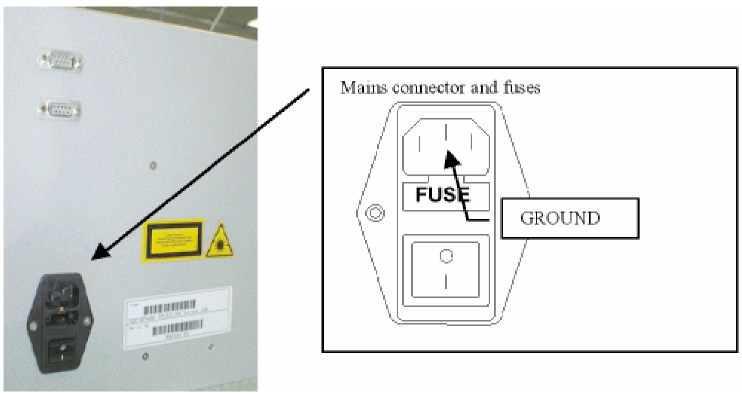


Fig. 26 mains connector

The TPR912 model has an internal AC/DC converter. With 220VAC power supply the efficiency is 75%. Each TFA has a power consumption of 12W, therefore a fully equipped configuration (6 TFLs) requires (12W x 6) / 0.75 = 96W.
This formula is helpful in verifying the overall power consumption.

27.2.2. DC negative supply

Direct current (–72 to –36 VDC) apply to TPR922 model only. Power connector is placed on the back panel (see
Fig. 27 VDC Connector (TPR922 only))

Fig. 27 VDC Connector (TPR922 only)

TPR922 model has an internal DC/DC converter: power consumption is the same as above.

Direct current (16 to 24 VDC) to be applied to TPR932 model only. Power connector is placed on the back panel (see Fig. 28 VDC Connector (TPR932 only))

Fig. 28 VDC Connector (TPR932 only)

TPR932 model has an internal DC/DC converter: power consumption is the same as above.

27.2.3. Grounding

Ground terminals are part of power supply connectors, as showed in previous figures (Fig. 26 mains connector, Fig. 27 VDC Connector (TPR922 only), Fig. 28 VDC Connector (TPR932 only)).
An external grounding terminal, with screw, is available at the back panel (see Fig. 29 ground)

Fig. 29 ground

28. Start up

- ✓ *WARNING: Verify voltage levels before connecting and powering on the subrack*

Please refer to system start-up section for further details.

29. Troubleshooting

The way a fuse is changed depends on the subrack version (refer to the datasheet). One or two fuses are present on the back of the rack, which needs to be replaced when they fail

Fig. 30 fuse

TFL-BSI RF attenuator

30. Introduction

This section describes the TFL-BSI (Base Station Interface). The TFL-BSI is part of the Britecell system and allows the operator to optimise the signal level the BTS or repeater and the Britecell system. It includes two independent variable attenuators (30 dB, one dB step) for uplink and downlink RF path.
A single attenuator version is available, for downlink only or uplink only operations.

31. Part description

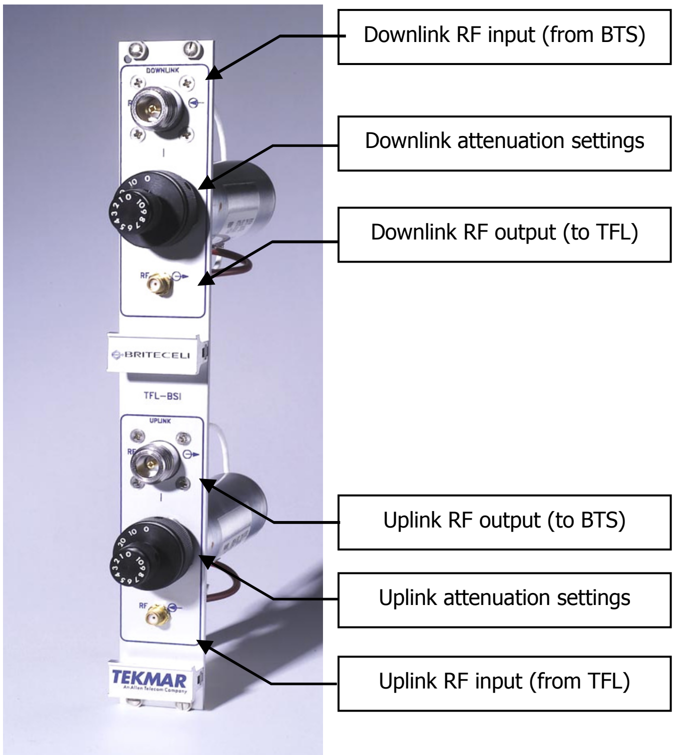


Fig. 31 - TFLBSI

32. Warnings

- ✓ *Maximum RF composite input power must not exceed 30 dBm.*
- ✓ *SMA connectors must be screwed with a proper dynamometric key.*

33. Functional description

33.1. Down link operation

If the RF signal coming from the BTS or repeater in downlink path has a power level, which is not adequate to the TFL's characteristics, an attenuator is required.

33.2. Uplink operation

The RF signal coming from the mobile through the TFA and TFL in the uplink direction may not be an optimal level. When this is the case, the uplink attenuator is used to prevent the BTS from being over driven.

34. Installation and cabling

34.1. TPR housing

The TFL-BSI is a modular plug-in card designed to be put in a 6 HE sub-rack (TPR family).
The TFL-BSI interfaces with the BTS transmitter and receiver through N-female connectors and with Britecell with SMA-female connectors.
The connection with the BTS may be direct, if the BTS's transmitter and receiver are separated, or through a circulator or a common path RF combiner (please refer also to THYB section).
When the system is air interfaced through a repeater a common path RF combiner is required in order to separate the uplink and downlink path.
The connection between TFL-BSI and Local Units may be direct or through a combiner stage (please refer to TLC section) depending on the system's configuration.

35. Calculation of attenuation setting

35.1. Downlink

Calculation of Downlink TFL-BSI setting is made in order to supply Britecell Local Unit with correct DL input power.

$$A_{BSI\_DL}[\mathrm{dB}] = (P_{@POI\_Input} - IL_{Dir.Cpoupler} - IL_{Comb.Net}) - P_{DL\_BC\_Max}$$

where:

$P_{@POI\_Input}$ [dBm/c]= RF power level per carrier at POI input:
$IL_{Dir.Coupler}$ [dB]= Directional coupler insertion loss (if present);
$IL_{Comb.Net}$. [dB]= Combining Network insertion loss;
$P_{DL\_BC\_Max}$ [dBm/c]= Max input power per carrier at Local Unit input.

35.2. Uplink

Calculation of Uplink TFL-BSI setting is made to meet BTS uplink blocking requirements.

$$A_{BSI\_UL\_blk}[\mathrm{dB}] = [P_{LU\_UL@Blocking} - (IL_{Dir.Cpoupler} + IL_{Comb.Net})] - P_{BTS@Blocking} + SM$$

where:
$P_{LU\_UL@Blocking}$ [dBm]= Local Unit output power when Remote Unit is at blocking level (3 dB C/N degradation);
$P_{BTS@Blocking}$ [dBm]= BTS receiver blocking level;
SM = Safe margin (typically 3 dB).

TLC RF combiner - splitter

36. Introduction

This section describes the TLC splitter/combiner. The TLC is part of Britecell system and provides a family of 2-way and 3-way RF power combiners in order to allow several local interface modules to be connected to common UL and DL RF paths, for interfacing to the BTS.
All units have internal pads (one per path) to achieve predefined insertion loss.

37. Part description

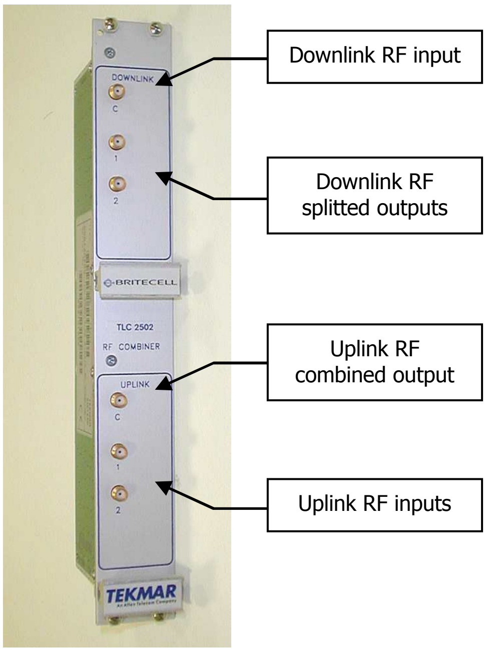


Fig. 32 TLC2502

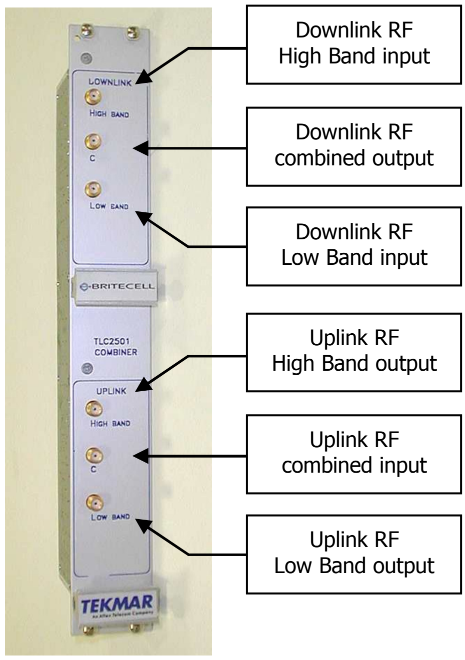


Fig. 33 TLC2501

38. Functional description

TLC2502/3 is a two/three way splitter for downlink path and combiner for uplink path. For insertion loss values refer to datasheets.
TLC2501 is a crossband coupler, designed to combine or split hi-band signal and low band signal in dual band systems. Insertion loss in this case is minimal (see datasheets).

39. Warnings

- ✓ *Maximum RF composite input power must not exceed 24 dBm.*
- ✓ *SMA connectors must be screwed with a proper dynamometric key.*

40. Installation and cabling

40.1. TPR housing

The TLC is a modular plug-in card, suited to be contained in a 6 HE Sub rack (TPR family).
The 2-way TLC module interfaces with the BTS transmitter and receiver through TFL-BSI and with TFL Local Units directly or through 3-way splitter/combiner.

THYB common path RF combiner

41. Introduction

This section describes the THYB common path RF combiner family. THYB is part of Britecell system and it allows combining of downlink and uplink path into a single one, while maintaining required isolation and stability.
This component has been designed for Britecell system configuration requiring single RF connector carrying both DL and UL signals when system is interfaced through a diplexed BTS.

42. Part description

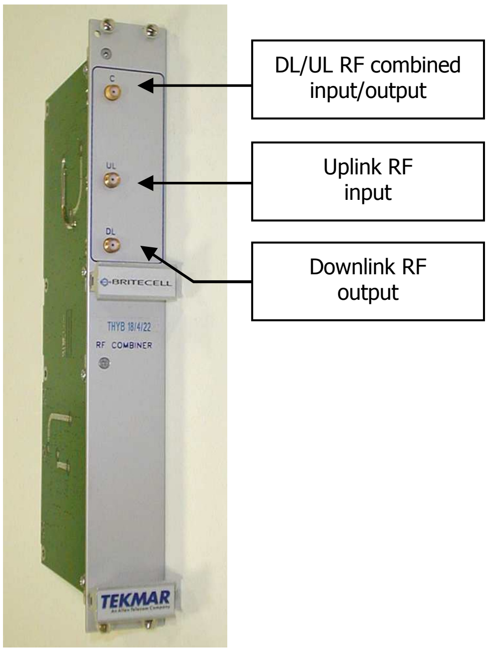


Fig. 34 THYB

43. Functional description

THYB is a bi-directional hybrid RF combiner/splitter. It can be chosen in single or dual band version. It's provided with uplink pass-band filters to improve UL isolation performances.
THYB typical application is in conjunction with diplexed BTS where DL and UL paths are provided in single RF connector.
For insertion loss value, refer to datasheets.

44. Warnings

- ✓ *Maximum RF composite input power must not exceed 30 dBm.*
- ✓ *SMA connectors must be screwed with a proper dynamometric key.*

45. Installation and cabling

THYB is a modular plug-in card, suited to be contained in a 6 HE Sub rack (TPR family). THYB interfaces with BTS transceiver through 'C' connector (type SMA-female). THYB interfaces with Britecell downlink and uplink paths through 'DL' and 'UL' connectors respectively (type SMA-female).

TFB booster

46. Introduction

The TFBxx is an optional part of the Britecell system and it's intended to enhance transmit power of Britecell remote transceivers TFA in order to maintain an output power of 10 dBm per carrier when operating with up to 8 carriers.
Typical TFB configuration is together with TFA remote unit and TPA passive antennae.
TFB is housed in the same metallic case as TFA and contains one amplifier for each direction (uplink and downlink).

47. Part description

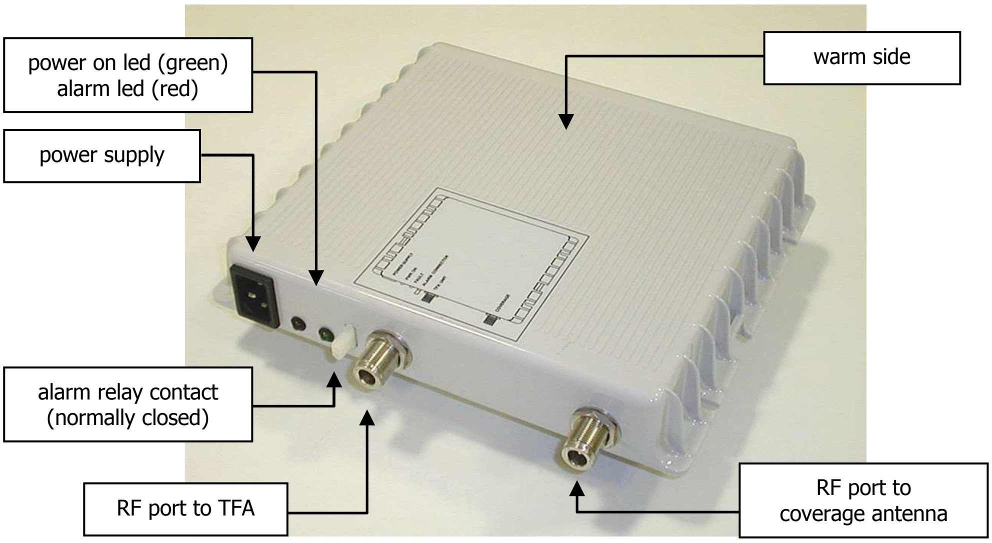


Fig. 35 TFB RF booster

48. Warnings

✓ *CAUTION! Do not connect the booster to TFA without first switching power supply off.*

49. Functional description

49.1. Block diagram

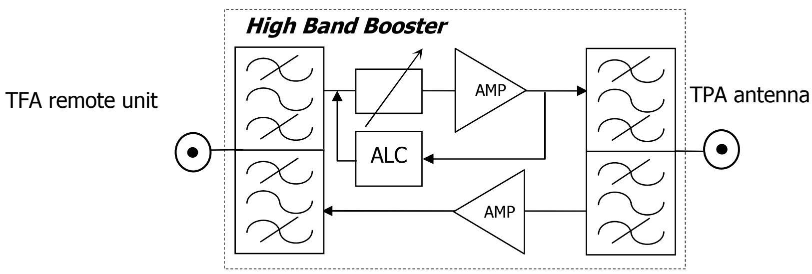


Fig. 36 block diagram

49.2. Description

TFB booster is a bi-directional RF amplifier designed to:

- improve the coverage area of the antennae connected to the remote unit while maintaining same amount of distributed RF carriers;

or

- improve number of distributed RF carriers while preserving the same coverage area.

Only single band version is available.
To enhance both RF ports of TFA remote unit, two TFB boosters are needed.

Downlink operation: in downlink path, the booster performs an overall gain of 14 dB. ALC (automatic level control) circuit provides automatic limitation of excess output power.
Uplink operations: in uplink path, the booster has an overall gain of 4 dB, which decreases the uplink noise figure (increasing system sensitivity).

50. Alarms

TFB provides a logic alarm related to excess current draw. The alarm output must be connected to TFA external alarm input , as shown in Fig. 37

Fig. 37

51. Installation and cabling

✓ *WARNING: for a proper connection of TFB to the Britecell system through the TFA. Please refer to the system coverage design for additional information.*

51.1. Location

TFB booster unit shall be installed close to TFA remote unit and radiating antennas, as to minimise coaxial cable length.
The unit is intended to be installed on walls, flat or orthogonal surface.
For a proper unit cooling take care of the warm unit side as indicated in Fig. 35
Installation must provide the correct positioning, and cables must be run so that accidental damage is prevented.

51.2. Power supply and grounding

51.2.1. Universal mains (85-264VAC, 50/60Hz)

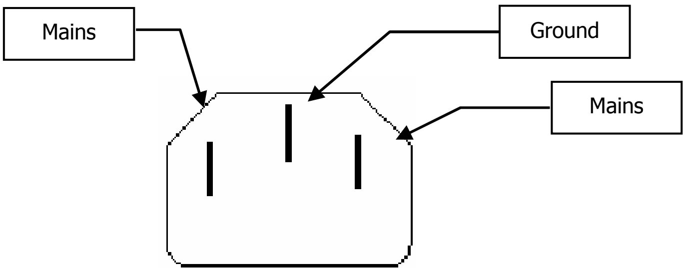


Fig. 38 -Mains connector

51.2.2. DC negative supply –72 to –36 VDC.

DC connector and part number:

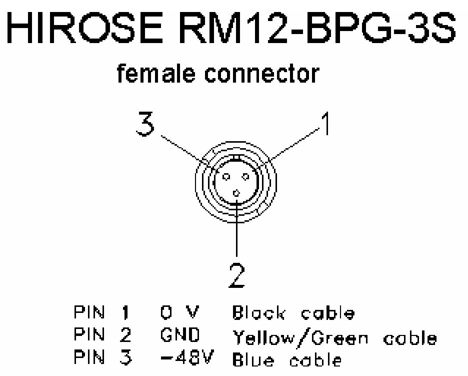


Fig. 39 - VDC connector

51.3. RF combined ports

Antenna port must be directly connected to radiating antennas through RF jumpers.
TFA port must be connected to combined port of TFA remote unit.

52. Start up

A preliminary verification of TFB correct operation is:

- power-up the TFB
- verify the following led status

LED	Colour	Status
Alarm	Red	OFF if internal operations ok
Power On	Green	ON

For a full functionality test please refer to the system start-up section

53. Troubleshooting

In case of alarm LED is active, check first if the air circulation around the unit is acceptable and that environmental conditions (operating temperature, supply range) are among specified operating limits.
If problems persists please refer to service or technical support.

TPA antenna

54. Introduction

This section describes the TPA antenna family. The TPA is part of Britecell system and provides the field shaped coverage.
TPA realises the physical radiating points, for radio transmission/reception, towards mobile stations. Each TPA is connected to the relevant Remote Unit TFA by means of coaxial jumper. TPA family ranges from single band stand-alone to dual band

Fig. 40 TPAx10 single band antenna

Fig. 41 TPAx20 dual band antenna

Fig. 42 TPAx30 dual band antenna

55. Functional description

The TPA extends cellular coverage in such indoor environments that can't be economically and easily reached by radio mobile network signals.
RF signals going through walls, metallic structures and any other obstacle inside buildings are attenuated up to 1000 times (30 dB), thus creating problems for the users of mobile phones.
TPA together with TFA solves this problem by providing a suitable amplification, which compensates the fading effect due to various artificial obstacles placed between mobile phones and Radio mobile Network.
The TPA can be high-gain directional or low-gain semi-directional, see product family datasheet for detailed radiation patterns
The appliance to the following instructions grants the best functioning, the maximum safety and the lowest inference with other electrical devices.
Any misuse and any violation of the device compromise its functioning and exclude any warranty.

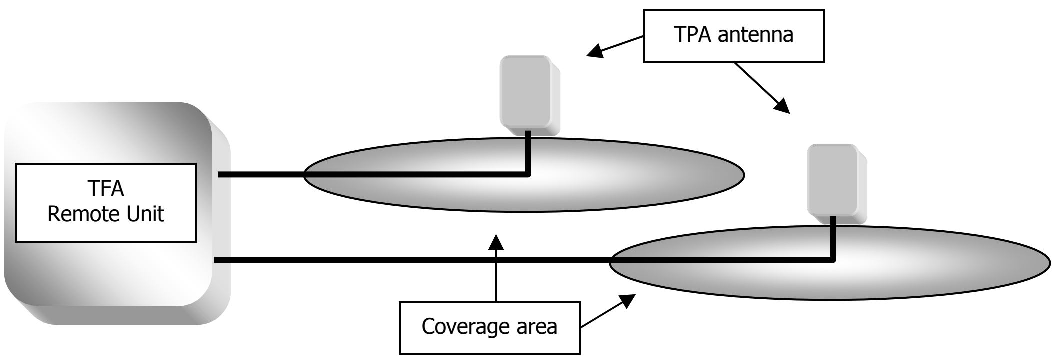


Fig. 43 block diagram

56. Installation and cabling

56.1. Location

Britecell transmits low-power radio signals in a given area. It is important to respect the simple installation instructions as follows, in order to achieve a good communication quality and to avoid malfunctions, which could bring to a self-inhibition of the device.

The TPA passive antenna's placing should be chosen in order to grant the maximum indoor radio coverage. The largest field is located perpendicular to the TPA. Antennas have to be mounted at a minimum height of 2.5m from the ground. They should not be placed near trees, plants, metal grids or other obstacles, which could disturb their functioning and lead to a worsening of the device's performance.

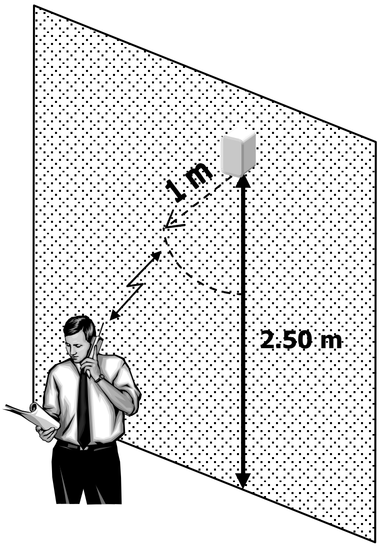


Fig. 44 antenna position

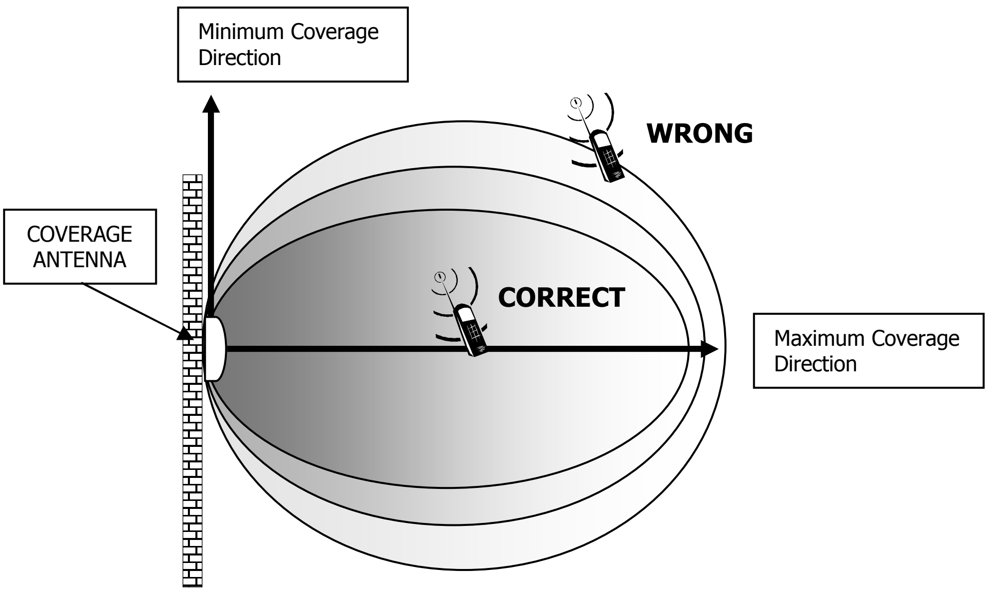


Fig. 45 radiation pattern

56.2. Location examples

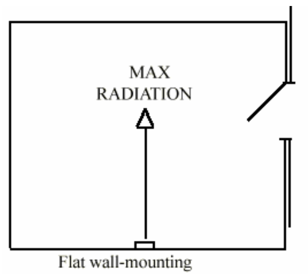


Fig. 46 Rectangular room

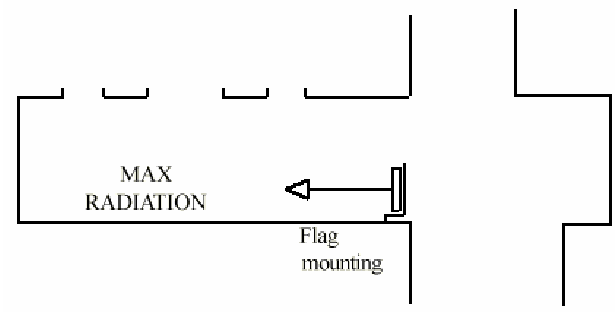


Fig. 47 Corridor

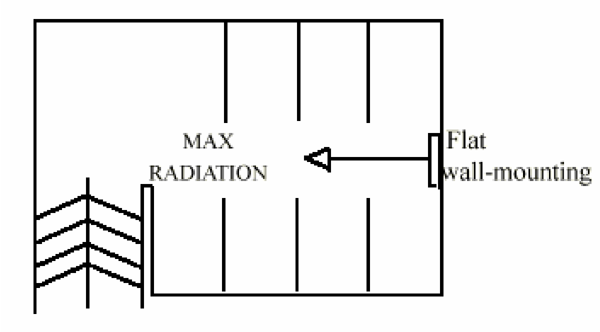
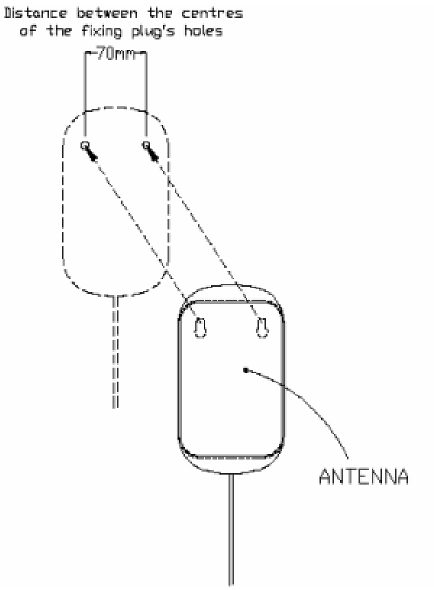


Fig. 48 Garage

56.3. Wall mount



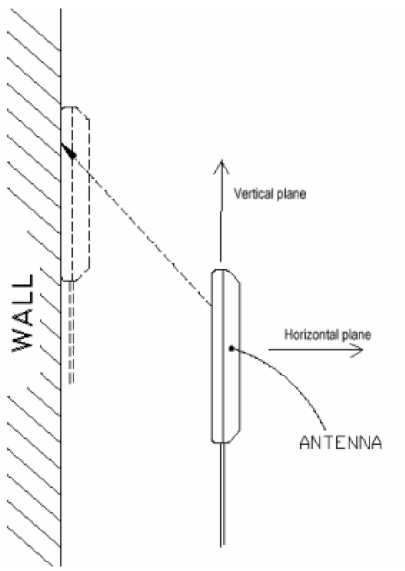


Fig. 49 Front view

fig. 50 Side view

56.4. Connectivity

There is either an N-female connector or a RG223 pigtail attached to the TPA antenna to realise connection to the TFA.

✓ *WARNING: use only low loss 50Ω RF cable to connect TPA antenna to TFA.*

✓ *WARNING: do not connect the antenna without switching off the power supply to the TFA.*

57. Troubleshooting & maintenance

The device has no particular maintenance requirements. It is advisable to check periodically the cable connecting the external antenna, in order to avoid any erosion or cut which could reduce its lifetime.

SYSTEM INSTALLATION

58. Installation and cabling

Britecell is designed to be simple and fast to install and commission. It requires a minimum number of tools and equipment. However, it is necessary to observe local regulations when planning and implementing an RF system and safety conventions must be strictly adhered to at all times. One unique hazard with Britecell is the presence of optical equipment; a thorough working knowledge of optics, and the safety procedures in their use, is required by the installation, commissioning and maintenance staff.

58.1. Local unit and subrack location

TFL Local Interface Units should be placed as near as possible to the BTS or the RF repeater and should be easily accessible as they provide visual alarm information for the system maintenance.

✓ *TPR 19" subrack needs proper air circulation. Take care that the operating temperature range is met.*

58.2. Remote unit and antennas location

The most efficient locations for the TFA Remote Transceivers will minimise the number of antennas required, whilst maintaining the coverage level goal.
Please refer to the system design for the proper antenna location.

✓ *The position of the remote unit should be vertical to improve the thermal dissipation.*

✓ *There should be easy access to the optical and RF cables.*

58.3. Fibre-Optic Cables

Britecell employs single-mode optic-fibre (SMOF) with the standard characteristic dimensions of 9µm (core)/125µm (cladding).
The amount of protection needed by the fibre varies from one application to another. A variety of cable designs are available to meet the requirements of different installations. Here are some examples:

- <u>Loose tube construction</u>: The fibre lies loosely inside a surrounding plastic tube so that it can adjust itself when the cable is distorted; microbending is almost completely eliminated by this technique. Loose tube cables are preferred for long distance links and for almost all outdoor applications.
- <u>Tight buffer construction</u>: the buffered fibre is completely enclosed in a cushioning material (secondary coating up to an external diameter of 900µm) to improve crush resistance and vibration isolation, minimising microbending. Tight buffer cables are usually adopted for indoor applications because they offer small cross-section dimensions and small bend radius.

For in-building applications the most common fibre cables are tight buffered cables with 2 fibres; examples are:

Duplex zip-cord: two simplex units in a zip cord configuration.

External Dimension (mm)	Maximum Tension (kg)	Weight (kg/km)	Minimum Bend Radius (mm)
2.5 x 5.3	30	11	30 (minor axis)

Duplex breakout cable: two individually coloured simplex units over sheathed in a "figure 0" configuration.

External Dimension (mm)	Maximum Tension (kg)	Weight (kg/km)	Minimum Bend Radius (mm)
3.6 x 6	30	24	35 (minor axis)

Duplex light duty wiring cable: two individually coloured tight buffered fibres surrounded by yarn annulus with a polymer over sheath.

External Dimension (mm)	Maximum Tension (kg)	Weight (kg/km)	Minimum Bend Radius (mm)
5	81	19	40

The main differences between these cables concern the maximum tension that they can bear; this is an important characteristic to consider as, during laying, installers often have to pull and to drag cables. For this reason the duplex light-duty wiring cable is preferred, which is light and allows a tight band radius.

58.3.1. Connecting TFL and TFA with optical cables

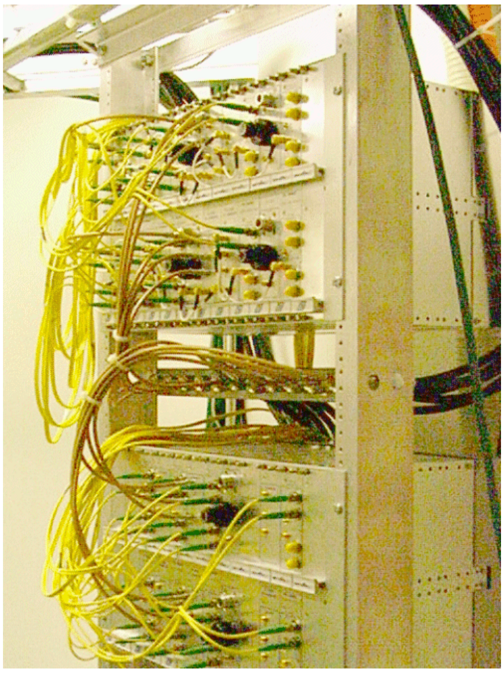
A couple of fibre optics connects every Remote Unit with a TFL. It is very important to well organise the layout of cables in order to avoid mistakes in the connection (correspondence between a certain remote unit and a TFL). Furthermore, a well-organised layout, allows good maintenance and troubleshooting.
Every fibre must be labelled in order to understand which is the correspondence between TFL port and Remote Unit.
During the connection of the pigtails to the TFL, some rules must be followed.

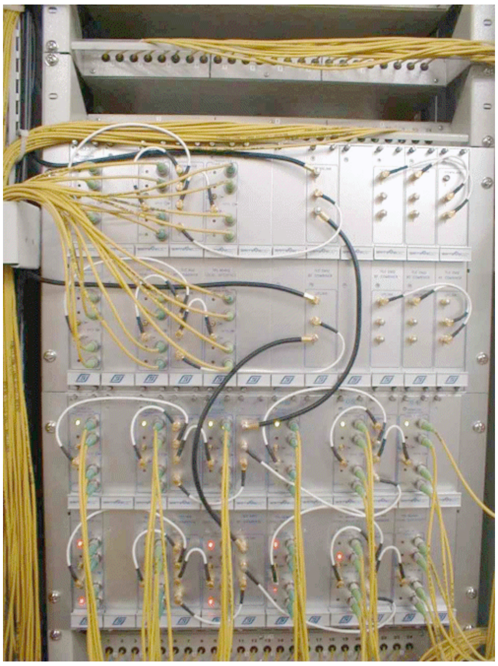
- ✓ *The pigtail cannot be squeezed or on traction and the minimum bend radius suggested is 4 cm.*
- ✓ *Don't touch the fibre optic head of the optical connector*
- ✓ *If necessary, clean the connector head by means of alcohol and proper paper*
- ✓ *Use dry air spray to clean the TFL optical connector. Firstly spray to another direction and then inside the connector as often some water can be on the first spray.*
- ✓ *Do not use other methods behind these to clean the optical connectors.*

58.3.2. Optical Cable Laying

Fiberoptic cables can be pre-terminated with appropriate fibre connectors, however, this often times causes problems if there is not enough space to pull through the connector, or if the cable lengths become very large. A qualified installer can make a recommendation on this matter. It is always recommended that extra fibre length be provisioned. The common (and recommended) method is to run the fibre cables without connectors attached and splice short pre-connectorised tails onto the fibre. This avoids damaging connectors in the cable-running process and ensures that adequate length is available at each end for correct routing and strain relief.
Note that angled connectors cannot be fitted in the field due to the accurate polishing process required; there is no significant loss in performance due to a fusion splice.

Inside the optical cable trunk, other kinds of cable cannot be installed.
The optical cable must not be stressed as this can cause a high insertion loss, and it could therefore break. For this reason it is important not to squeeze the cable, for example tightening the fixing stripes too much.
It's a good rule of thumb to avoid bending the optical cable within a radius of less than 10 cm. Consequently, the cable trunk installation must be done respecting that norm.
The following are pictures of actual cabling, one correct, one incorrect.





WRONG BETTER

fig. 51 - system cabling

58.4. Power Supply

A Britecell system may be locally (at each remote unit) or distributed powered. There are advantages with both methods. It may be faster and cheaper to use local power, however it is easier to back-up a system when the power originates at a single point. A power supply may be distributed in a composite cable (copper and fiber), or two separately parallel cables may be run. Note that the cable containing the copper conductors must carry the appropriate plenum rating and must be of sufficient conductor area to ensure adequate voltage at the furthest Remote Unit under full load. Refer to TFA datasheet for power consumption specifications.

If Local Units subrack is to be co-located with a BTS it is often desirable to power the entire system from the battery-backed low voltage supply available. The Local Unit card is fitted with a universal AC power supply module but can be ordered with -48VDC modules instead. The overall power consumption of a full equipped subrack will not exceed 110W.

A general rule for subrack power consumption is:

(Local Unit consumption [W]) x (cards number) / 0.75 = overall consumption [W]

59. SYSTEM START-UP

In order to avoid damaging the equipment, the following criteria must be used to start up the system:

1. Verify all the power supply connections.
2. Verify all the RF connections.
3. Verify all the optical connections.
4. Set all the adjustable attenuators on the TFL-BSI at the maximum value of attenuation.
5. Switch on the local units sub-racks.
6. Check for alarm status and in case of alarm refer to troubleshooting paragraph.
7. Connect the spectrum analyser at the input of one TFL and measure the level of the carriers for every operator.
8. Set the adjustable attenuators in order to have the right level of the carriers at the input of the TFL according to the technical specifications.

60. MAINTENANCE

60.1. Plug-in cards removal

✓ *Always switch off subracks power supply before removing or inserting any active plug-in card.*

60.2. Optical equipment

It is a good rule when working with the fibre optic components, to always have available the appropriate screw covers for closure of the optic connectors that are not connected. The intrinsic fragility of an optic connection must be highlighted. A minimum layer of dust causes a notable increase of the insertion loss, therefore.

✓ *Always close the optic connectors that are not connected, with the appropriate screw covers.*

✓ *Always use compressed gas to remove any deposits in the receptacles before closing them.*

✓ *Use the appropriate cloths to clean the connectors.*

✓ *Do not allow the male connector to come into contact with skin or oily surfaces.*

✓ *Should it be necessary to clean the optic connector, use pure alcohol only.*

OTHER INFORMATION

61. TERMINOLOGY

The following acronyms are commonly used throughout the document:

AC	Alternating Current
AM	Amplitude Modulation
AMPS	Advanced Mobile Phone System (US 800 MHz standard)
BTS	Base Transmission Station (cellular system element)
DC	Direct Current
DCS	Digital Communication System (European 1800 MHz standard)
DL	Down-link (radio path from BTS to subscriber)
EMC	Electro-Magnetic Compatibility
ETACS	Extended Total Access Communications System (European 800MHz standard)
GSM	Global System for Mobile
IMD	Intermodulation Distortion
LNA	Low-Noise Amplifier
LV	Low Voltage
SMOF	Single Mode Optical Fibre
PCB	Printed Circuit Board
PCS	Personal Communications System (US 1900 MHz standard)
RF	Radio Frequency
TFA	Britecell remote transceiver (also called Fiber Remote Unit)
TFL	Britecell local interface unit (also called Fiber Donor Unit)
UL	Up-link (radio path from subscriber to BTS)
UMTS	Universal Mobile Telecommunication System

62. WARRANTY CONDITIONS

Customer service is granted all over the world during and after the warranty period.

Allen Telecom warrants to the terms and conditions hereto set forth, all products manufactured by it to be free under normal use and service from defects in materials and workmanship for a period of one (1) year from the date of shipment to the first consumer (the "Warranty Period").
The warranty applies only if:

a) the warranty period is not expired;
b) the defect is imputable to the product.

Our obligation under this Warranty is limited to prompt repair or replacement of the product, without charge, when the product is returned to the factory.
The warranty shall not apply to any product which has been repaired or altered in any manner or if the defect, malfunction or failure of the product was caused by damage by lightning, flood or other acts of nature or by power surges, or from unreasonable use, or from improper installation or application, or to any product which has not been maintained or used in accordance with the operating specifications set forth in this manual.
Allen Telecom evaluates if the product can be repaired or if it is necessary to replace the unit.

In case the product is out of warranty, the customer will be informed about the cost for repairing or replacing the unit. The service will be provided only after receiving Customer's authorisation.

Before returning the goods, the customer should give prior notice to Allen Telecom through normal return authorisation procedure.

Allen Telecom aims to offer an excellent service. To do that we ask our customer to enclose to the returned product an accompanying letter, including the following information

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

* refer to the serial label

N.B.: each product must be packaged with care before shipment.

Allen Telecom will issue a check report, which is included in the packing together with the product being returned. The customer will be informed about any corrective actions suggested by quality assurance.

63. DECLARATION OF CONFORMITY

Allen Telecom

Declares

That the device related to this usage and maintenance handbook comply with the CE mark requirements, according to the Low Tension Rules 73/23/CEE and Electro-magnetic compatibility Rules 89/392/CEE

Allen Telecom will carefully retain the technical file related to the device design, together with this usage and maintenance handbook, for a minimum time span of 10 years.

Signature: Managing Director of Tekmar Sistemi S.r.l.

64. TECHNICAL SUPPORT

For further information on the product, not described in this publication, please contact our helpdesk:

Tekmar Sistemi s.r.l – technical support & system engineering
Via De Crescenzi 40 - 48018- Faenza - ITALY
tel ++39.0546.697111
fax ++39.0546.682768

An online service using our Internet site is available.

web: **http//:www.tekmar.it/helpdesk**
e-mail: **info@tekmar.it**

APPENDIX

65. APPENDIX A - Britecell system design basics

65.1. Indoor propagation

Radio signals from wireless mobile telephone systems are located in the high UHF spectrum, between 800MHz and 2,2GHz, according to the common standards such as ETACS, AMPS, GSM, DCS, PCS, UMTS, etc.. At such high frequencies electromagnetic waves are subjected to phenomena like diffraction and reflection; these effects become dominant in cellular systems where propagation rarely occurs in free space.

In a cellular system a single radiation point is normally provided for each cell or sector, located at the BTS site. This may not have line of sight to every user in the coverage area.

The simultaneous occurrence of diffraction and multiple reflections (multipaths) in the indoor environment makes this the most critical, as far as signal propagation and coverage is concerned. The presence of natural or artificial openings and obstructions (such as walls) leads to a mean loss term, which is normally higher than the free space loss.

The point is easily reached in indoor environments where the radio link loss exceeds the maximum loss, determined by the transmitter power and receiver sensitivity, for acceptable communication quality. This can happen in a few spots of a room, affecting uniform coverage, or in entire sections of the building.

A common issue is the need to provide sufficient signal level in all parts of a structure to dominate the signal from a local external cell, ensuring that calls originating within the building are set-up on the internal system. This can add a considerable challenge to the in-building coverage design as very high signal levels may be required close to external openings, such as doors and windows.

When supplying cellular coverage to indoor environments, in order to reach full network performances, receive levels at both the BTS and mobile handset must be kept uniformly high by keeping link loss as low as possible. This can be obtained using Britecell.

When supplying coverage to indoor composite areas, the radiation points should be planned to be in line of sight with the mobile so that the radio link loss can be kept consistently low.

The location of the BTS is no longer determined by the required radiation point; more practical BTS locations are thus feasible and the radiation point locations can be optimised to suit the coverage area.

Deploying a Britecell system fulfils these criteria. By using fibre optic guided propagation very low link losses can be achieved, allowing signals to be carried long distances in the building without appreciable degradation. Specific areas can be targeted to fit traffic distribution, regardless of obstructions or location; cell planning is simplified with minimum or no changes in network parameters setting.

In addition, the use of Britecell can avoid the introduction of further BTS's, where coverage is required but there are no requirements for more traffic channels. This can achieve considerable savings in the cellular system rollout.

65.2. Fibre-optic transmission

Britecell uses an analogue modulation scheme for the transmission of the composite RF signal through the fibre optic link; the optical carrier is intensity modulated.

Distortion is critical in cellular systems due to the multiple carriers present and the regular channel spacing ensures that the products usually occur on the frequency of another channel.

To minimise these problems Britecell uses high performance single mode lasers as RF to optical transducers, the characteristics of which are dominant in the link performance. Single mode optical fibre (SMOF) is employed due to its very low loss, enabling signals to be carried for long distances when matched with sensitive optical receivers.

With Britecell optical links in excess of 1.5 km can be achieved without appreciable degradation of signal characteristics. Care must be taken to keep back reflection of the optical carrier below -36 dBC to avoid additional link noise and signal distortion.

We can detect two contributions to back reflection in optical links:

Microscopic variations in the refractive index in the fibre cause scattering of the light; this depends on fibre length and can be kept within allowable limits by limiting the length.

Concentrated reflections, due to refractive index discontinuity's in the fibre are the dominant source of returned light. These occur mainly at optical connectors so, to reduce the severity, Britecell uses angled connectors, which direct reflected light out of the fibre core. Only a negligible portion of light from the interface is reflected back towards the source; return losses of greater than 60 dB can be achieved with angled optical connectors.

In case that the system operates on a digital standard, a fundamental parameter for the transparency is propagation delay through fibre, especially when the indoor coverage extends an existing outdoor coverage of a BTS because of the need for an outdoor-indoor overlap area. In this case differential delay between the direct and repeated paths must be minimised. For example, the upper limit for GSM systems is 8µs.

The velocity factor of silica glass optical fibre is 0.65, giving a propagation delay in the fibre of 5ms/km; the Britecell equipment has a negligible contribution.

Optical fibre needs only a little care to be taken in system implementation and maintenance to avoid possible malfunction. It offers many major advantages in in-building coverage design, apart from the ability to carry signals long distances. Significant additional benefits are:

- High bandwidth capacity
- Electromagnetic Compatibility (EMC) of fibre optics is inherent in all environments; fibre is insensitive to electromagnetic fields, lightning or radiation and produces no interference to other equipment.
- SMOF cables for indoor applications can be very thin, easy to install and to hide; thus they permit a low visual impact on the environment and a minimum effort in their laying.
- Support structures can be minimal and no plenum-rated jacketing is required for use inside structures (unless copper conductors are incorporated).

Refer to the following sections for more information on the design and installation fibre cabling in Britecell systems

65.3. Coverage method

The greatest benefit of Britecell fibre optic distribution system is the possibility to place non obtrusive antennas where the coverage is needed, i.e. near the mobile users.

The coverage targets, in terms of signal levels, are meant to be achieved by placing radiating points inside the building.

Antenna locations are selected in order to:

- minimise path loss to mobiles in the public areas of the building,
- minimise number of remote antenna sites.

A careful planning of antenna position allows to achieve a low attenuation radio link, since it minimises the effect of obstacles and it brings the radiating points close to the mobile stations, often achieving a quasi line of sight propagation.

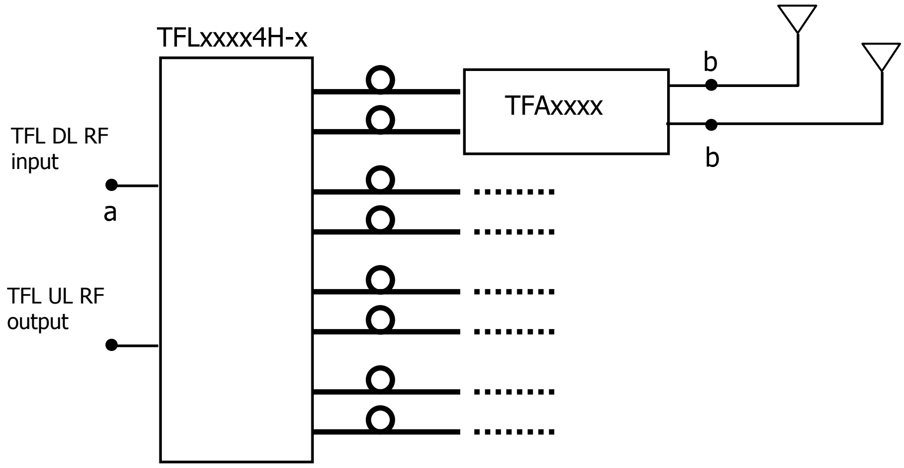
This also greatly reduces the fading effects. As a result, good quality radio links can be achieved with low down link and up link transmit powers.

The low power Distributed Antenna System (DAS) provides uniform and well confined coverage inside buildings.

66. APPENDIX B - Britecell input power level setting

66.1. Down link power levels

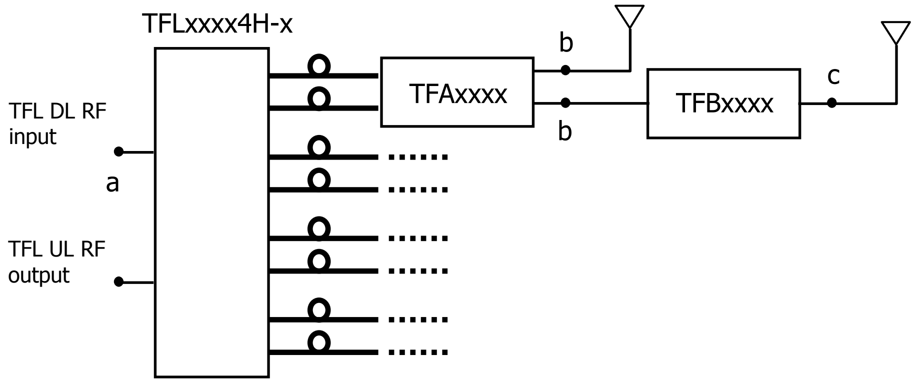
In order to achieve spurious products below the limits set forth in various governmental specifications (eg. -36 dBm for GSM900, –30 dBm for GSM1800) the input power at the TFL downlink input port should be set according to the following table. FCC specifications (-13 dBm- AMPS, PCS) are somewhat more lenient and are also dependent on spectral mask requirements.



NUMBER OF CARRIERS (N)	Max power per carrier at TFL DL RF input (**a**) $P_{IN\ TFL}$ /carrier [dBm]	Max power per carrier at TFA RF output (**b**) $P_{OUT\ TFA}$ /carrier [dBm]
2	3,0	10,0
3	0,7	7,7
4	-0,3	6,7
5	-1,2	5,8
6	-1,8	5,2
7	-2,3	4,7
8	-2,7	4,3
9	-3,1	3,9
10	-3,4	3,6
11	-3,7	3,3
12	-4,0	3,0
14	-4,5	2,5
16	-4,9	2,1
18	-5,2	1,8
20	-5,6	1,4
22	-5,8	1,2
26	-6,4	0,6
30	-7,1	-0,1
34	-7,6	-0,6
40	-8,3	-1,3

NOTES:
DL power levels for Britecell 900 MHz and Britecell 1800 MHz

66.2. Down link power levels: remote unit + booster



NUMBER OF CARRIERS (N)	Max power per carrier at TFL DL RF input (**a**) $P_{IN\ TFL}$ /carrier [dBm]	Max power per carrier at TFA RF output (**b**) $P_{OUT\ TFA}$ /carrier [dBm]	Max power per carrier at TFB RF output (**c**) $P_{OUT\ TFB}$ /carrier [dBm]
1	0,0	7,0	20,0
2	-4,0	3,0	16,0
3	-6,3	0,7	13,7
4	-7,3	-0,3	12,7
5	-8,2	-1,2	11,8
6	-8,8	-1,8	11,2
7	-9,3	-2,3	10,7
8	-9,7	-2,7	10,3
9	-10,1	-3,1	9,9
10	-10,4	-3,4	9,6
11	-10,7	-3,7	9,3
12	-11,0	-4,0	9,0
14	-11,5	-4,5	8,5
16	-11,9	-4,9	8,1
18	-12,2	-5,2	7,8
20	-12,6	-5,6	7,4
22	-12,8	-5,8	7,2
26	-13,3	-6,3	6,7
30	-13,8	-6,8	6,2
34	-14,1	-7,1	5,9
40	-14,6	-7,6	5,4

NOTES:
DL power levels for Britecell 900 MHz + TFB915
DL power levels for Britecell 1800 MHz + TFB1815

The DL levels at Booster output assume that the cable connecting TFA and booster has 1 dB loss.

67. APPENDIX C - Classifying hazardous areas

Hazardous Area
A hazardous area is defined as: "An area in which a flammable substance in the form of gas or vapour or dust, when mixed with air, is present in such proportions that it can explode when in contact with an ignition source.

Area Classification
Hazardous areas are classified with respect to the potential danger or an explosion, and the areas are divided into zones:

CONDITIONS	CE Code	EC
Continuously Hazardous	Division 1	Zone 0 - An area in which an explosive gas/air mixture is continuously present or is present for long periods.
Periodically Hazardous	Division 1	Zone 1 - An area in which an explosive gas/air mixture is likely to occur under normal operating conditions.
Occasionally Hazardous	Division 2	Zone 2 - An area in which an explosive gas/air mixture is unlikely to occur, but if it occurs, it will be of short duration.

Gases & vapour classification
Gases are grouped together basing on the amount of energy required to ignite the most explosive mixture of the gases with air. Equipment is classified into groups according to the gases and vapours for which it is suitable and must be selected with a grouping, which covers the gases and vapours which, will be present where it is to be installed:

Group	Representative Gas	Ignition Energy
I	Methane	320 Microjoules
IIA	Propane	300 Microjoules
IIB	Ethylene	160 Microjoules
IIC	Hydrogen	40 Microjoules

GAS	CE CODE	IEC
Acetylene	Class I, Group A	Group IIC
Hydrogen, Butadiene, Ethylene Oxide, Propylene Oxide, or Acrolein	Class I, Group B	Group IIC
Ethylene, Cyclopropane, Ethyl Ether, or Ethylene	Class I, Group C	Group IIB
Propane, Acetone, Alcohol, Ammonia, Benzine, Benzol, Butane, Gasoline, Hexane, Laquer Solvent vapours, Naptha, Natural Gas	Class I, Group D	Group IIA
Coal Mines	Gaseous Mines	Group 1
Combustible Dusts	Class II	
Ignitable Fibres or Flying	Class III	

To ensure the suitability of electrical equipment for use in hazardous areas, the equipment is certified and uses various techniques known as Methods of Protection. As not all Methods of Protection are suitable for all hazardous areas, care must be taken to select equipment, which is suitable for use in the Zone in which it is installed.

Zone 0	Zone 1	Zone 2
Ex ia - Intrinsic safety Ex s - Special protection if specifically certified for Zone 0	Method suitable for Zone 0 Ex ib - Intrinsic Safety Ex d - Flameproof enclosure Ex e - Increased safety Ex m - Encapsulation Ex s - Special protection	Method suitable for Zone 0 or l Ex N - Type of protection N Ex o - Oil immersion* Ex q - Powder filling* Ex p - Pressurised or purging
* may be suitable for Zone 1		

68. APPENDIX D - Health and safety warnings

Antenna installation must conform within the following guidelines to meet FCC RF exposure limits, otherwise an environmental evaluation is required if:

Broadband PCS (subpart E):	
Non building mounted antennas:	Height above ground level to lowest point of antenna< 10m Radio (Part 24) and total power of all channels > 2000 W ERP (3280 W EIRP)
Building-mounted antennas:	Total power all channels>2000W ERP (3280W EIRP)
Narrowband PCS (subpart D):	
Non-building-mounted antennas:	Height above ground level to lowest point of antenna < 10m Radio (Part 24) and total power of all channels > 1000 W ERP (1640 W EIRP).
Building-mounted antennas:	Total power of all channels > 1000 W ERP (1640 W EIRP).
Cellular Radiotelephone Service (Part 22, subpart H):	
Non-building-mounted antennas:	Height above ground level to lowest point of antenna < 10m Radio (Part 22) and total power of all channels > 1000 W ERP (1640 W EIRP).
Building-mounted antennas:	Total power of all channels > 1000 W ERP (1640 W EIRP).
Paging and Radiotelephone Service (Part 22, subpart E):	
Non-building-mounted antennas:	Height above ground level to lowest point of antenna < 10m Radio (Part 22) and total power of all channels > 1000 W ERP (1640 W EIRP).
Building-mounted antennas:	Total power of all channels > 1000 W ERP (1640 W EIRP).
Private Land Mobile Radio \ Specialized Mobile Radio (Part 90):	
Non-building-mounted antennas:	Height above ground level to lowest point of antenna < 10m Radio (Part 90) and total power of all channels > 1000 W ERP (1640 W EIRP).
Building-mounted antennas:	Total power of all channels > 1000 W ERP (1640 W EIRP).