5. Rack-based Master Unit

5.1. TPRNx4 subrack

Major TPRN features

The TPRNx4 is a 19”subrack where all the Britecell Plus plug-in modules can be inserted. Britecell Plus equipment provides a wide variety of these sub-rack models differentiated by power supply. Each one is provided with:

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

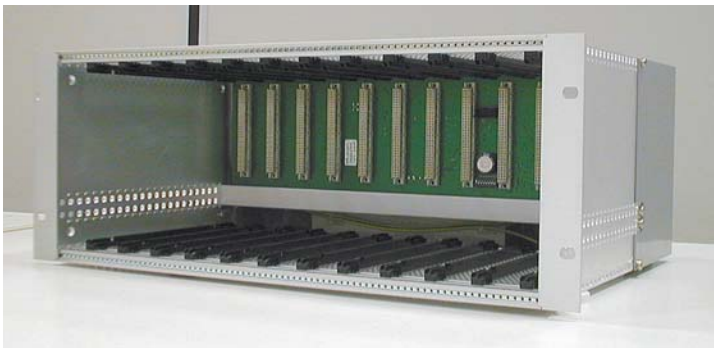


Fig. 5.1: Front view of the TPRN sub-rack with power supply and communication ports on the back

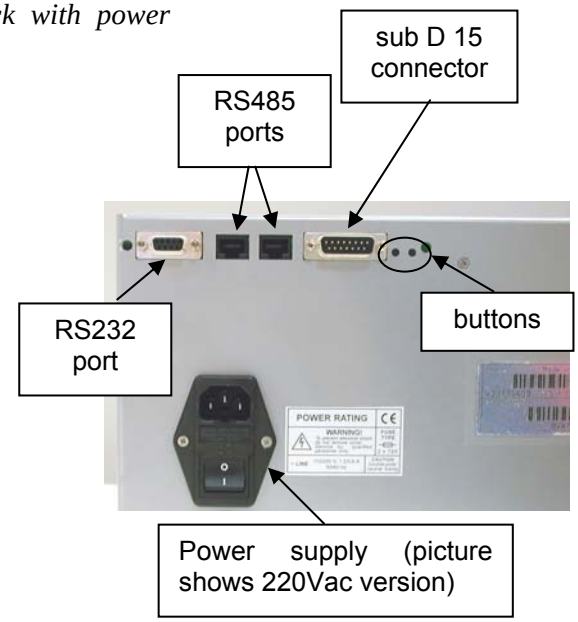


Fig. 5.2: Back view of the TPRN sub-rack with power supply and communication ports on the back

TPRN models

A brief description of all the available TPRN sub-racks is reported hereinafter.

Passive sub-rack (TPRN04)

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

220 Vac powered sub-racks (TPRN14 / TPRN24)

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

-48Vdc powered sub-rack (TPRN34)

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

TPRN power supply

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

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

This connector is mounted on the TPRN back panel either for the redundant version or the simple one. A ground terminal and a couple of fuses are also included. Fuses have to be replaced in case they fail (when it happens the supervision system detects the failure).

Fig. 5.3: 85 to 264Vac connector

-48 Vdc
(-72 to -36 Vdc)

This connector is mounted on TPRN back panel. A fuse is provided underneath the –48 Vdc connector, and has to be replaced in case it fails (when it happens the supervision system detects the failure).

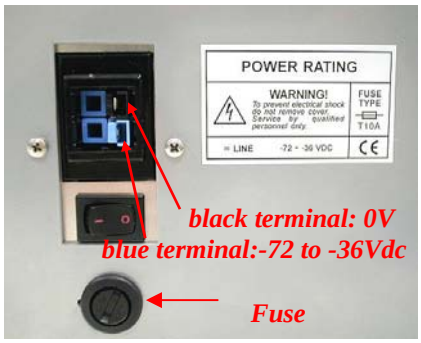


Fig. 5.4: -72÷-36Vdc connector

Whatever power supply is chosen (85 to 264 Vac or -72 to -36 Vdc) an additional external ground terminal is provided on the TPRN rear (fig. 5.5).

Fig. 5.5: ground terminal on the rear

The external power supply (220Vac or -48Vdc) is converted into a +12Vdc voltage allowing feeding the active modules inserted into the TPRN.

TPRN ports

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

RS232 serial port

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

The connection baud rate can be set to 9600bps or 19200bps, by properly setting the dip-switch 5 standing on the interior TPRN backplane (fig. 5.6). The baud rate setting through dip-switch 5 is shown in table 5.1.

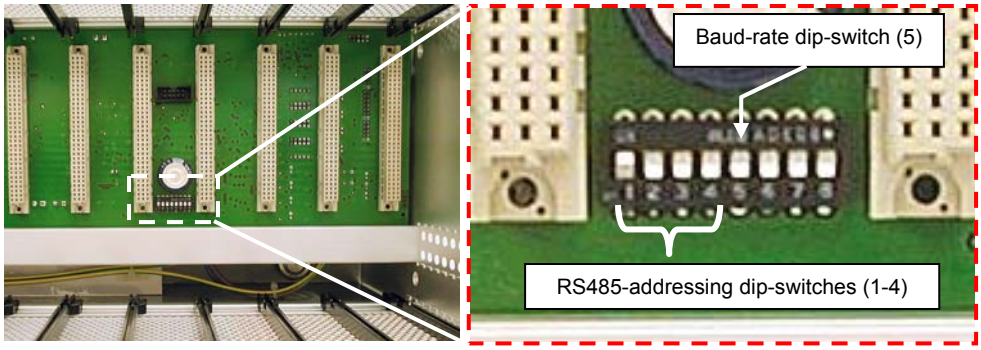


Fig. 5.6: Dip-switches on TPRN backplane.

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

Table 5.1: Setting RS232 baud rate through dip-switch 5

Whichever baud rate you choose through dip-switch 5, remember that:

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

RS485 port

The RS485 port consists of two RJ45 connectors, which can both work as input or output ports towards a RS485 bus.

This RS485 bus has to be used in order to connect a multi sub-rack system to the remote supervision unit. In this case:

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

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

TPRN

The binary address assignment can be done through dip-switches 1,2,3,4, which stand on interior TPRN backplane (see figure 5.6). A list of the correspondences between the addresses and the dip-switches is provided by table 5.2: simply note that dip-switch 1 is the least significant binary digit, while dip-switch 4 is the most significant one.

Address	Dip-switch 1	Dip-switch 2	Dip-switch 3	Dip-switch 4
0001	ON	OFF	OFF	OFF
0010	OFF	ON	OFF	OFF
0011	ON	ON	OFF	OFF
0100	OFF	OFF	ON	OFF
0101	ON	OFF	ON	OFF
0110	OFF	ON	ON	OFF
0111	ON	ON	ON	OFF
1000	OFF	OFF	OFF	ON
1001	ON	OFF	OFF	ON
1010	OFF	ON	OFF	ON
1011	ON	ON	OFF	ON
1100	OFF	OFF	ON	ON
1101	ON	OFF	ON	ON
1110	OFF	ON	ON	ON

Table 5.2: Dip-switches address settings

The baud rate of the RS485 ports is the same of the RS232 port as per the dip-switch 5 setting.
Whichever baud rate you choose, remember that:

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

Sub-D 15 poles male connector

The TPRN sub-rack provides a sub-D 15 poles male connector, shown in fig. 5.7.

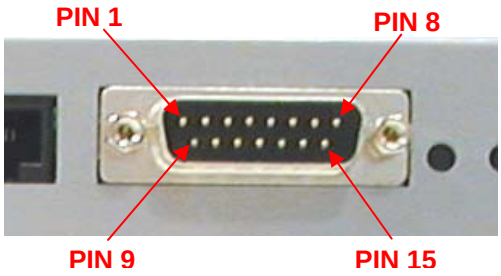


Fig. 5.7: sub-D 15 poles male connector

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

Tab. 5.3: Functional description of pins provided by sub D male connector.

As highlighted in the previous table, this connector provides:

- 4 opto-isolated input ports which can be used to reveal any failure condition on external equipment. The default status of these input ports can be defined through the supervision system. After that, any change from default status will be revealed as a failure signal.
- a summary of major and minor alarms related to failures detected not only on the TPRN sub-rack, but also on any active modules hosted by the TPRN itself.
- 2 relay output ports, which be can used to drive any external device connected to subD-15 pins adapter. By using the supervision system each of these output ports can set up on "open" or "close" conditions.

A more detailed description of the meaning and functionality of each pin are reported in table 8. The pins are numbered from left to right, and from top to bottom (refer to fig. 18).

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

TPRN alarms

A full description of all TPRN alarms is provided by the Supervision system.

The table 4.8 provides a brief description of the TPRN alarms, as they are reported by the LMT software o

TPRN

ALARM CODE (TSUN description)	ALARM DESCRIPTION	ACTIVE LED	SUPERVISION PRIORITY LEVEL	ACTION RECOMMENDED	RELÉ PRIORITY LEVEL (subrack)
Redundant supply active (only for redundant power supply versions)	Backup power supply activated	YELLOW	MAJOR	Return the unit	MINOR
Power Supply alarm	There is a degradation on the power supply provided to the boards	RED	MAJOR	Return the unit	MAJOR
I2CBUS bus error	Internal I2CBUS communication malfunction	YELLOW	CRITICAL	Check if the fault is on the unit (see supervision system). If not return the unit	MINOR
Temperature alarm	Over-temperature alarm	YELLOW	MINOR	Check ventilation and environment	MINOR
Aux input alarm nr0	The device connected to the input alarm port 0 caused an alarm condition	RED	CRITICAL	Check the status of the connected device	-
Aux input alarm nr1	The device connected to the input alarm port 1 caused an alarm	RED	MAJOR	Check the status of the connected device	-

	condition				
Aux input alarm nr2	The device connected to the input alarm port 2 caused an alarm condition	RED	MINOR	Check the status of the connected device	-
Aux input alarm nr3	The device connected to the input alarm port 3 caused an alarm condition	RED	WARNING	Check the status of the connected device	-

Tab. 5.4: Description of the alarms of the TPRN subrack

Warning (recommended for system designing and installing)

Providing a correct heat dissipation

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

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

Minimizing equipment costs

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

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

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

If you are installing a multi-sub-rack system, remember to assign each sub-rack an exclusive binary address, by properly setting dip-switches 1,2,3,4 on the interior TPRN backplane (see fig. 5.6 and Tab.5.2). Dip-switch 5 has to be set on each TPRN sub-rack in order to fix the baud rate for RS485 and RS232 port. Connecting TPRNs through RS485 port is necessary when supervising the whole multi sub-rack system through the remote supervision unit (to be set at the same baud rate).

TPRN Installation

The TPRN kit provides:

- 1 TPRN sub-rack
- 1 suitable power cord
- 1 standard RS232 cable (male-female), 2m
- 1 CD Manual

First of all insert the sub-rack into the cabinet and apply 4 screws (not provided) in order to fix it (fig. 5.8a).
To have a correct TPRN installation, distance between the front door of the rack and the front side of the TPRN should be at least 15cm otherwise RF and optical cables can be damaged when cabinet door is closed.

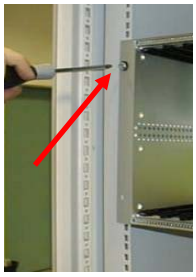


Fig. 5.8(a): At each front-corner the subrack is provided with a screw in order to be fixed to the

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

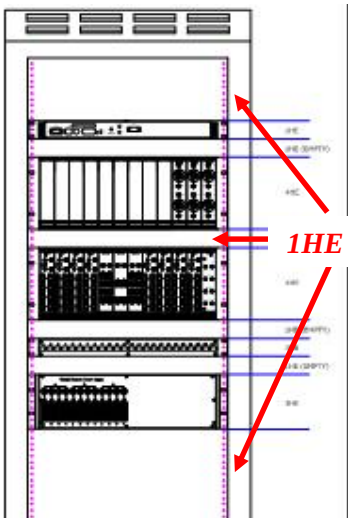


Fig. 5.8(b): Distance between subracks should be at least 1HE in order to facilitate air circulation

Connect the ground to the safety ground terminal. Then, connect the power supply connector to the mains.

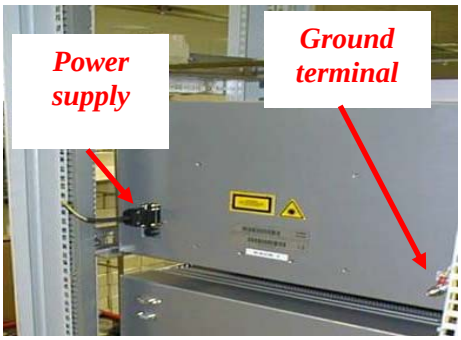


Fig. 5.8(c) : Power supply and ground terminals on the rear side of the TPRN subrack

TPRN Start-up

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

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

Remember that TFAx remote units have to be switched on before relevant Master Unit.

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

- About 10sec after the TPRN sub-rack has been switched on, all TFLN modules housed in the TPRN itself begin a "discovery" phase in order to identify and collect status of the connected TFAx remote units. While the discovery phase is working (max. 4min. depending on the system complexity) each TFLN general alarm (i.e., LED "┌┘") blinks, whereas the other TFLN LEDs go on showing the detected status.

  Do not connect/disconnect any cable or piece of equipment until all TFLN modules have finished the discovery phase. This may result in failing the identification of TFAx. Anyway during the discovery phase, the whole system still works correctly as discovery process aims to collect information about TFAx but without affecting basic system functionalities.

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).

- Once the discovery has finished, the general alarm (i.e. the LED "┌┘") on each TFLN panel stops blinking and switches OFF (provided that the TFLN master optical TRX is not affected by a general failure).

TPRN troubleshooting

In case a TPRN sub-rack shows any problem a more detailed status and alarm description could be provided through the remote supervision unit.

A complete overview of TPRN alarms is reported in the previous Table 5.4.

The power supply degradation occurs in case the +12Vdc power falls below an in factory set threshold level. In this case, TPRN automatically turns to standby mode so that no over-current gets through the circuitry of hosted modules, thus preserving the system integrity. Once power supply has been repaired, the TPRN needs to be rebooted. In case the TPRN sub-rack is equipped with a redundant power supply (TPRN24), a degradation of the +12 Vdc power results in an automatic switching from main to spare converter. In case also redundant power supply degrades the TPRN automatically turns to stand-by mode. Once the power supply has been repaired the TPRN needs to be rebooted.

TPRN

I^2Cbus alarm occurs when TPRN sub-rack cannot communicate with one or more hosted module. Each TPRN slot is able to automatically detect the presence of a module inside the slot. If the module is detected but TPRN is not able to communicate with it through I^2Cbus alarm is activated.

Note: at commissioning remember to mask the unused slots through LMT software (please refer to the relevant manual for more information) to avoid not significant alarm being switched on.

In order to carry out a troubleshooting procedure, please check LMT or supervision system handbooks.

5.2. Master Optical TRX, TFLN

TFLN

Module name:

Master Optical TRX

TFLN

Main tasks carried out by the TFLN module

Downlink (DL):

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

Uplink (UL):

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

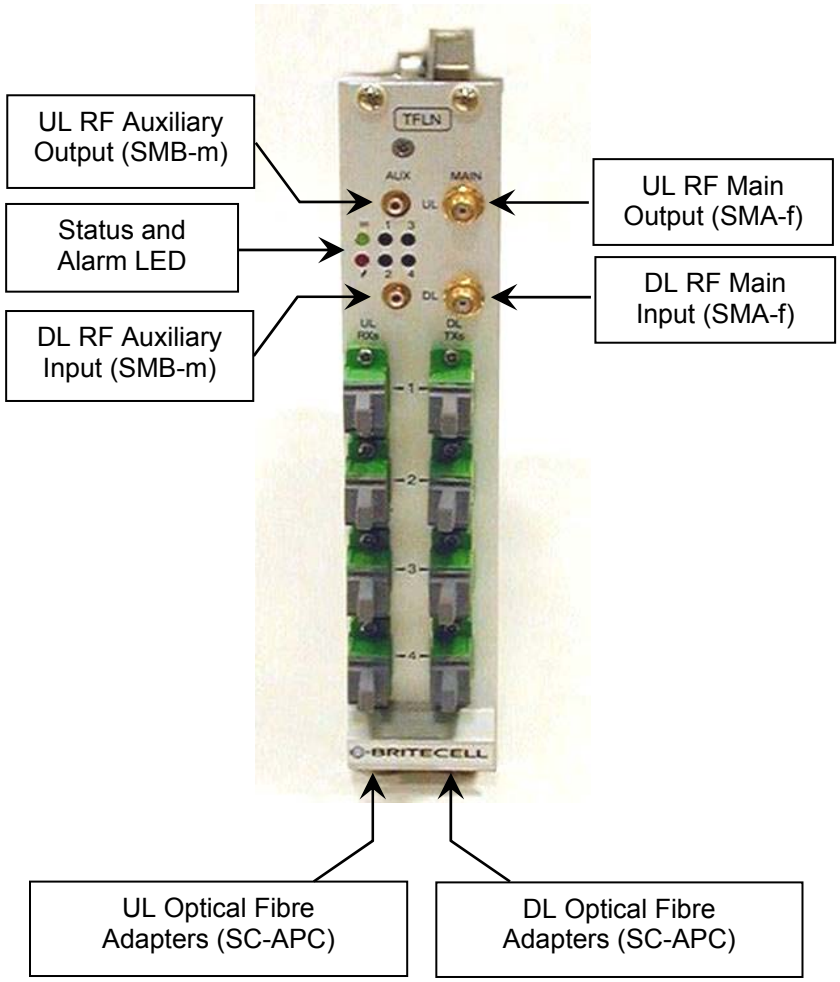


Fig. 5.9 . The TFLN Master Optical TRX

RF ports

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

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

Optical ports

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

TFLN visual alarms

The TFLN front panel is provided with 6 LEDs (see on the right), showing status and alarm information.
LED meaning is reported on the rightward table.
Further information about alarm status is delivered by Britecell Plus supervision system.

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

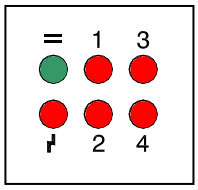


Fig. 5.10 :LED panel on TFLN front side

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

Tab. 5.4: Meanings of the LEDs on TFLN front-side

TFLN power supply

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

Warnings (to be read before the TFLN installation)

Dealing with optical output ports

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

Handling optical connections

- 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. See fig. 19 for optimal fibre cabling.
- Remove adapter caps only just before making connections. Do not leave SC-APC adapters open, as they attract dust. Unused SC-APC adapters must always be covered with their caps.
- Do not touch the adapter tip. Clean it with a proper tissue before inserting each connector into the sleeve. In case adapter tips need to be better cleaned, use pure ethyl alcohol

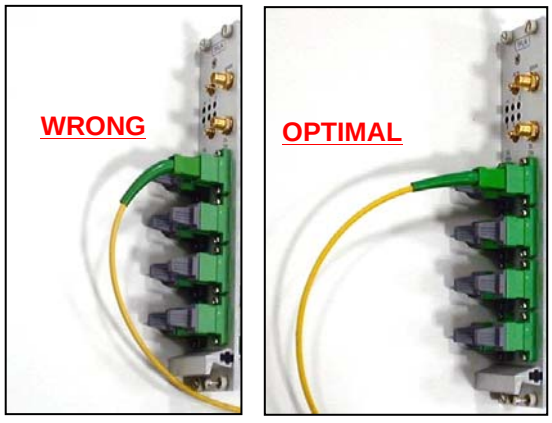


Fig. 5.11: Fibre Optic bending

Inserting or removing TFLN modules

- Do not remove or insert any TFLN module into TPRN sub-rack before having switched off main power supply.
- The TFLN modules must be handled with care, in order to avoid damage to electrostatic sensitive devices.
- When installing TFLN modules in the sub-rack, take care to alternate active and passive cards in order to ensure proper heat dissipation.

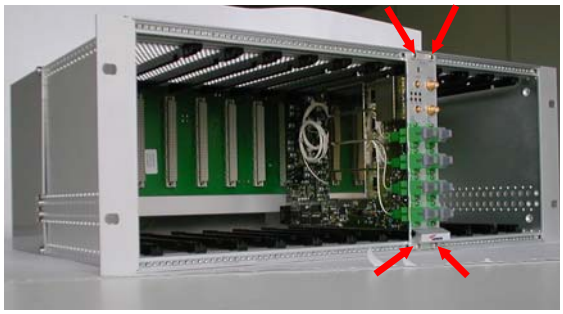
- In a multi-sub-rack system, remember to assign to each sub-rack a proper RS485 bus address before installing the modules (please refer to TPRN section for further details).

TFLN positioning

- In case no ventilation system is installed, do not insert more than 8 TFLN modules into a sub-rack.
- In case more than 8 TFLN modules have to be housed into a TPRN sub-rack, it's advisable to install the TPRN sub-rack inside a rack with forced ventilation.
- Take care to meet expected requirements on RF ports. An adjustable attenuator could be necessary when the power coming from the BTS exceeds the required levels to avoid damages in Britecell Plus circuitry or increase of spurious emissions.

TFLN installation

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



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

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

Fig. 5.12: Screws to be fixed at the corners of the TFLN front side

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

Fig. 5.13: UL and DL RF cables are to be fixed by a torque wrench

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

Fig. 5.14: Take off the caps and connect the fiber optics cables properly

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

TFLN start-up

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

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

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 TFLN behaviour at system start-up can be summarized as per the following steps:

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

   Note: In case unused optical ports of the TFLN have not been masked through LMT yet, corresponding LEDs will be on. If so, wait for the end of step 3 (discovery phase) then use LMT to mask them (please refer to relevant handbook)

2. About 10 seconds after the system has been switched on, TFLN module begins a "discovery" phase to identify connected remote units. This operation is necessary to collect all the information to be provided to the supervision system.

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

Table 5.5: Status of the TFLN LEDs in full-working conditions

During the discovery phase the TFLN general alarm (LED ⌐┘) blinks while the other LEDs go on showing previously detected status. Time dedicated to discovery phase can be at maximum 4min and depends on system complexity.

Do not connect/disconnect any cable or any piece of equipment during the discovery phase. This may result in failing the identification of remote units.
Please note that, while the discovery phase is running, the whole system is working correctly as discovery operations aim only to collect information about remote units without affecting the system functionalities.

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

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

Removing a TFLN module

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

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

TFLN troubleshooting

In case a TFLN master optical TRX has any problem, this will be easily revealed through LEDs on its front panels otherwise troubleshooting can be carried out through LMT or supervision system.
LEDs on TFLN front panel detect not only failures of the TFLN board itself but they also reveals malfunctions located on related remote units.

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

Tab. 5.6: TFLN alarm description

The previous table reports a brief description of the TFLN alarms, together with a reference to the corresponding alerted LEDs.
As the table shows, LEDs on the TFLN front panel signal all high priority alarms while minor alarms, which detect critical situations which should be checked and tested in order to avoid future possible system faults, are only revealed by LMT or supervision system.
Each TFLN is provided with an AGC system which compensates optical losses <3 dB. TFLN LED alarms switch on when the estimated optical losses are >4dB, the AGC not being able to compensate these losses any more.
One of LEDs 1, 2, 3 or 4 might turn on not only to indicate a high optical loss detected by TFLN, but also to reveal a remote unit failure. Understanding the reason why one of LEDs 1, 2, 3 or 4 is on (a remote unit failure, an optical cable fault or an external equipment malfunction) can be done following the troubleshooting procedure reported hereinafter.

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 5.15a)

1. In case the TFLN general alarm (LED ┌┘) is on replace the faulty TFLN master optical TRX with a new one and contact the manufacturer for assistance.
2. In case one of the LEDs 1, 2, 3 or 4 is on, the corresponding TFLN 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 TFAx warm side:
    a. If it is off, the optical cables or the optical connections are supposed to have some problem on UL path. Refer to fibre optic UL troubleshooting for more information (fig. 21).
    b. If it is on, refer to remote unit troubleshooting presented in the previous remote unit section

Fibre optic UL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 5.15b)

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 TFLN red 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. TFLN and TFAx ports). If not fix better SC-SPC connectors to relevant adapters. If this makes the TFLN red 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. TFLN side and TFAx side) then reconnect the fibre to relevant ports. In case this makes the TFLN red LED switch off, troubleshooting has been successful. Otherwise, follow next steps.
4. Disconnect the optical SC-APC connector from TFLN 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, check the TFAx status on supervision system and contact for assistance

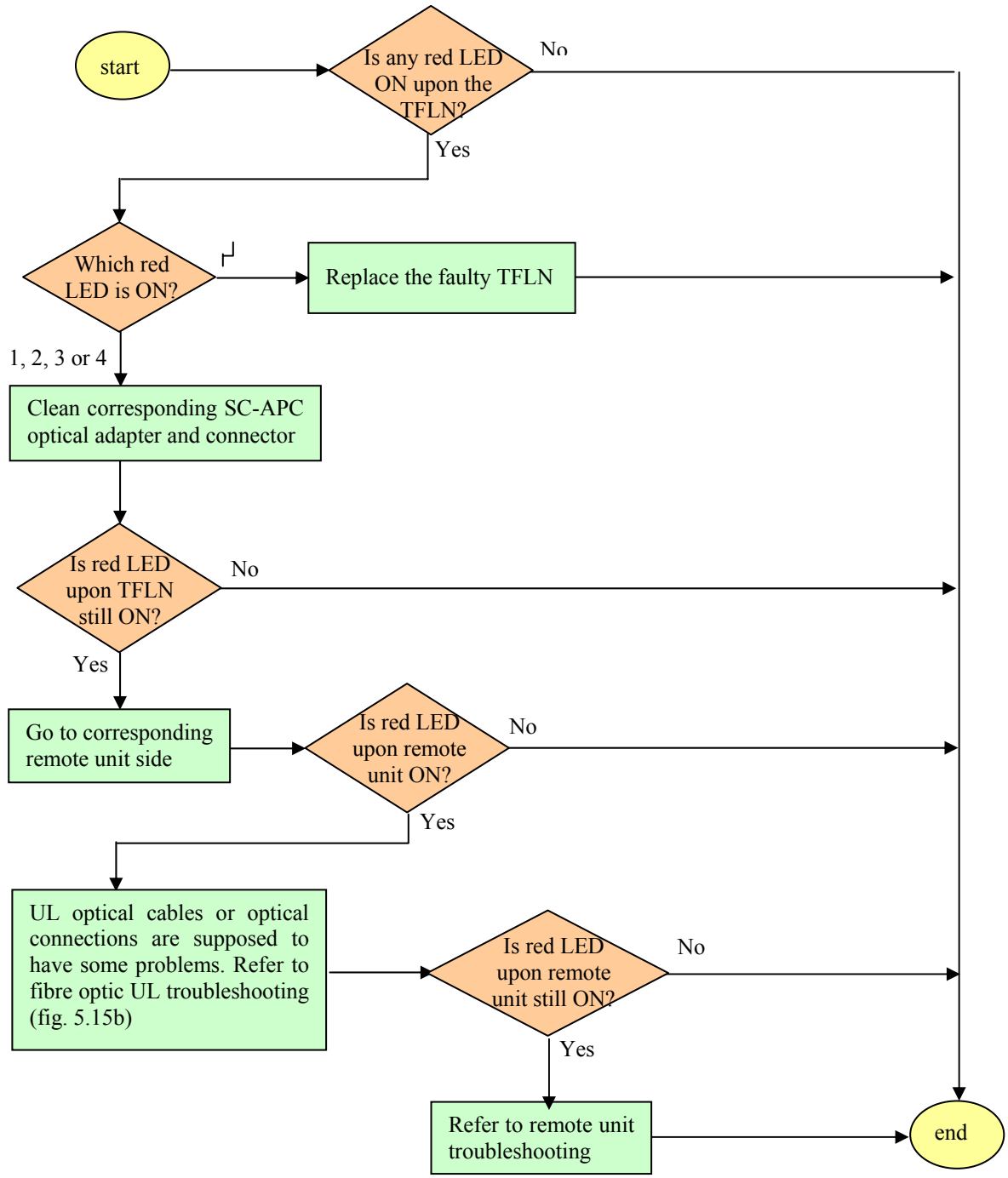


Fig. 5.15 (a): Flow-chart describing the quick troubleshooting procedure

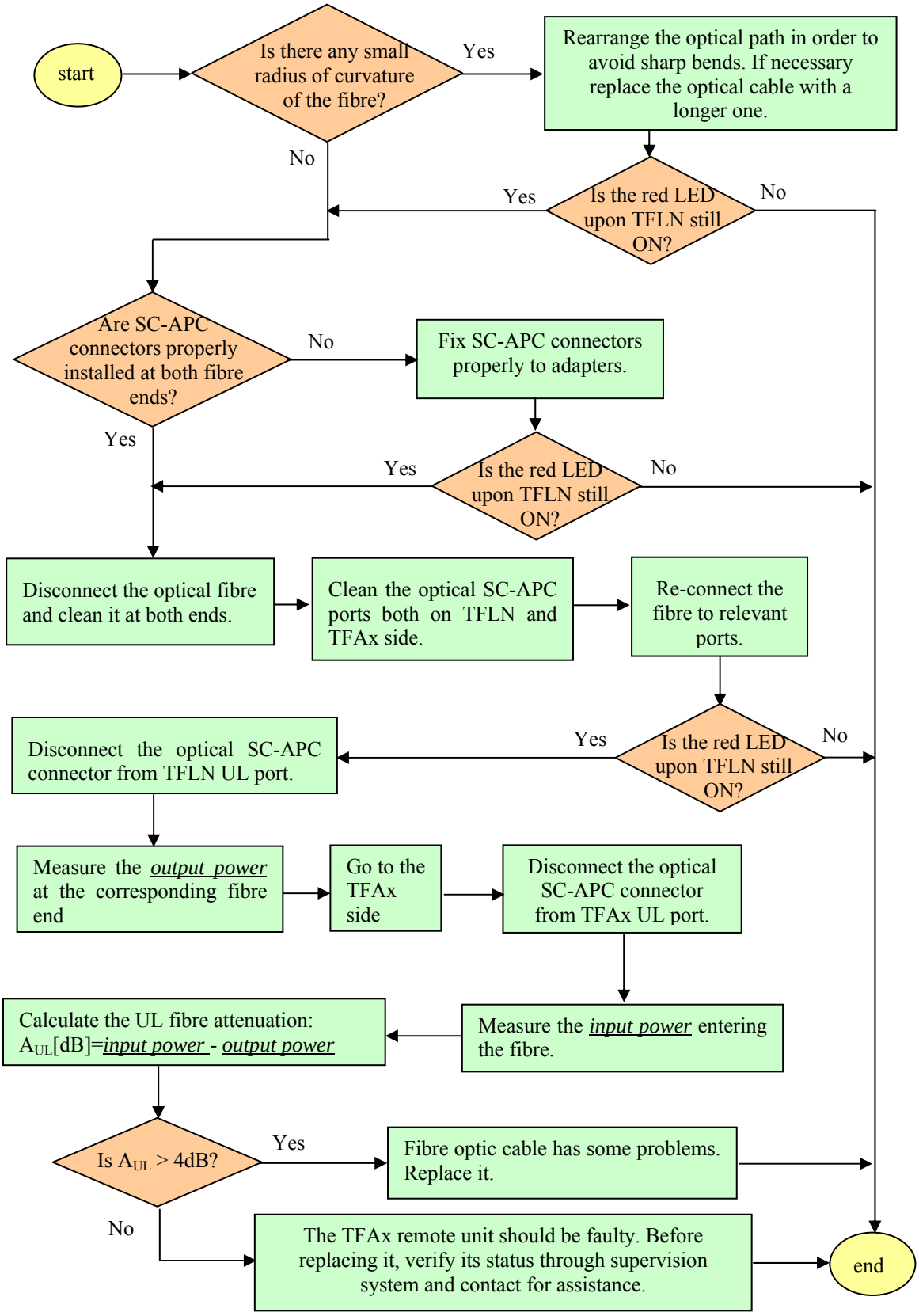


Fig. 5.15 (b): Flow-chart describing the fibre optic UL troubleshooting

5.3. Two-way Splitter/Combiner, TLCN2

Module name:

2-way splitter/ /combiner

TLCN2

Description:

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

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

It is a passive wideband module.

RF ports:

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

Note: each port is bidirectional.

TLCN2 main applications

Main applications of the TLCN2 module are:

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

More TLCN2 modules can be used in cascade connections.

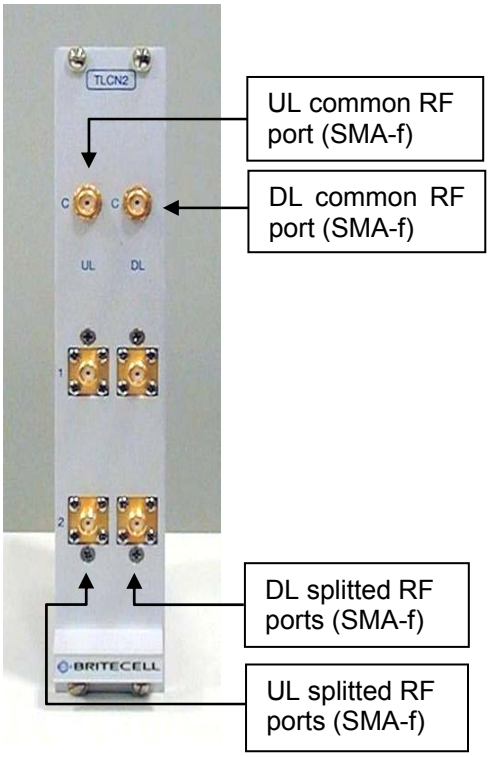


Fig. 5.16: TLCN2 splitter/combiner

TLCN2 insertion loss

The TLCN2 insertion loss varies slightly with the frequency bands, as shown in table 5.7.
When designing the system, remember to take into account the insertion loss of the TLCN2 if present.

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

Table 5.7: Insertion loss values within different frequency bands

Warnings

The overall input power must not exceed +24dBm

TLCN2 Installation

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

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

5.4. Four-way Splitter/Combiner TLCN4

Module name:

4-way splitter/ /combiner *TLCN4*

Description:

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

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

It is a passive wideband module.

RF ports:

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

Note: each port is bidirectional.

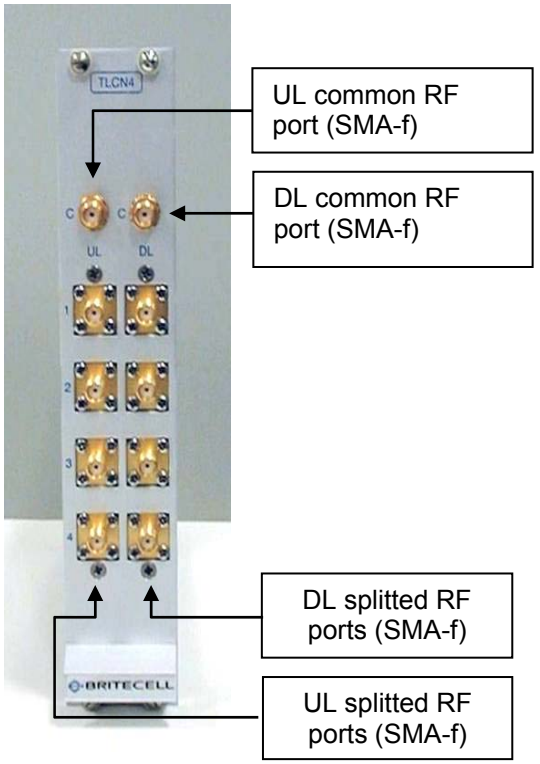


Fig. 5.17: TLCN4 splitter/combiner

TLCN4 main applications

Main applications of the TLCN4 module are:

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

More TLCN4 modules can be used in cascade connections.

TLCN4 insertion loss

The TLCN4 insertion losses vary slightly with the frequency bands, as shown in table 5.8.
When designing the system, remember to take into account the insertion loss of the TLCN4.

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

Table 5.8: Insertion loss values within different frequency bands

Warnings

The overall input power must not exceed +24dBm

TLCN4 Installation

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

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

5.5. RF Dual band Coupler TLDN

Module name:

RF dual-band coupler

TLDN

Description:

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

Main operations carried out are:

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

It is a passive module.

RF ports

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

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

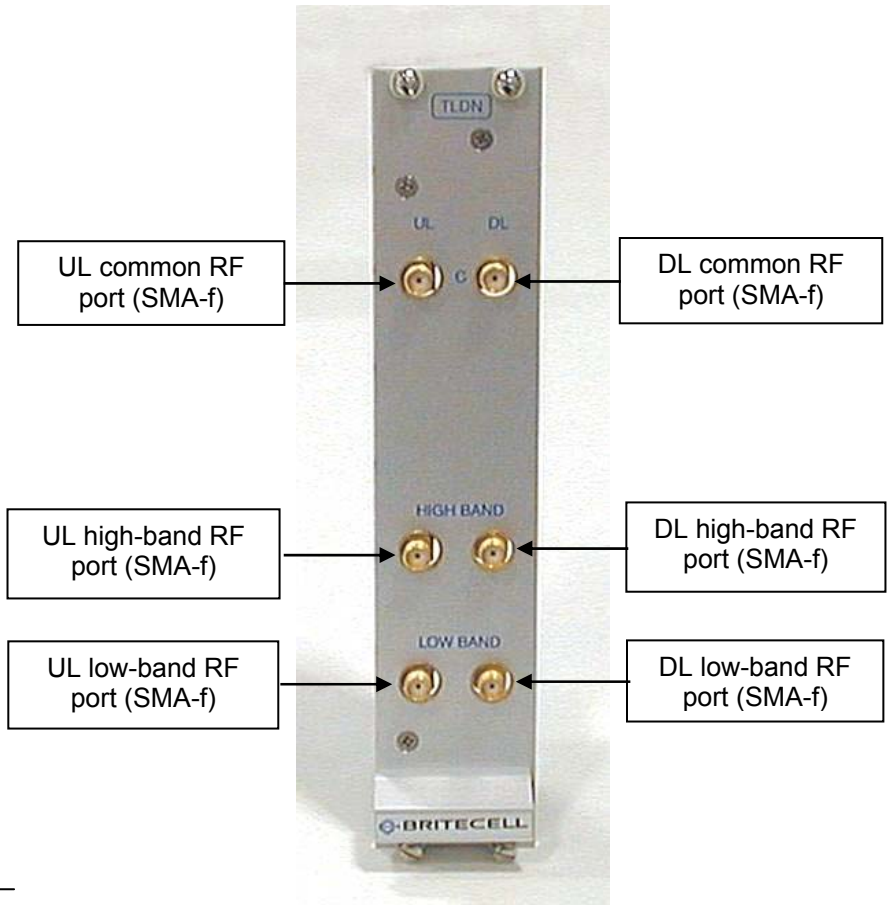


Fig. 5.18: The TLDN dual-band coupler

TLDN main applications

Main applications of the TLDN module are:

- Connecting 2 donor sources with different services to one TFLN master optical TRX in a dual band system, so that:
  - TLDN combines the DL inputs coming from the 2 different donor sources (carrying different services) into an output signal entering the TFLN master optical TRX

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

TLDN insertion loss

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

Warnings

The overall input power must not exceed +27dBm

TLDN Installation

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

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

5.6. RF Tri band Coupler TLTN

Module name:

RF tri-band coupler

TLTN

Description:

The TLTN is a passive RF tri band coupler designed to distribute signal within the master unit when coming from different bands.

Main operations carried out are:

- in downlink it combines a 800MHz to 1000MHz, a 1700MHz to 2000MHz signal and a 2000MHz to 2200MHz signal into a single RF path
- in uplink it filters a composite signal into a 800MHz to 1000MHz, a 1700MHz to 2000MHz signal and a 2000MHz to 2200MHz one.

It is a passive module.

RF ports

- 1 DL common RF output port ("C") for the combined DL signal
- 1 DL 2000MHz to 2200MHz RF input port
- 1 DL 1700MHz to 2000MHz RF input port
- 1 DL 800MHz to 1000MHz RF input port
- 1 UL common RF input port ("C") for the combined UL signal
- 1 UL 2000MHz to 2200MHz RF output port
- 1 UL 1700MHz to 2000MHz RF output port
- 1 UL 800MHz to 1000MHz RF output port

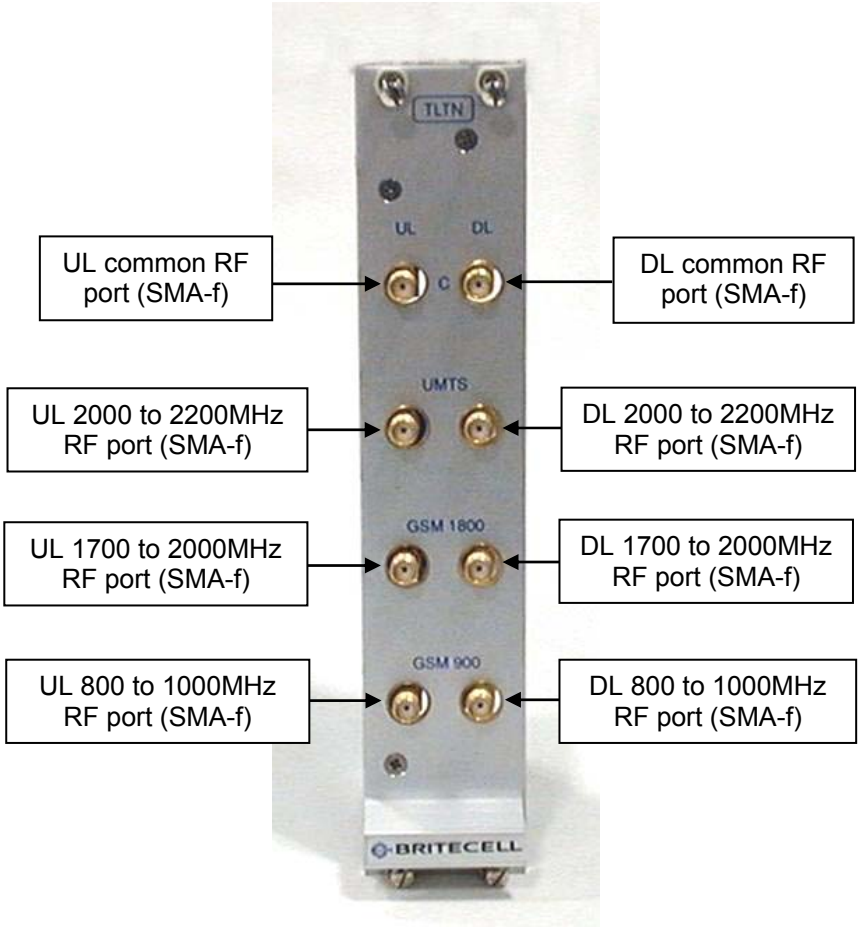


Fig. 5.19: The TLTN tri-band coupler

TLTN main applications

Main applications of the TLTN module are:

- Connecting 3 donor sources with different services to one TFLN master optical TRX in a tri band system, so that:

- TLTN combines the DL inputs coming from 3 different donor sources (carrying different services) into an output signal entering the TFLN master optical TRX
- TLTN filters the UL input coming from the TFLN master optical TRX into 3 UL outputs entering 3 different donor sources (carrying different services)

TLTN insertion loss

TLTN insertion loss = 3.0 ± 0.5dB

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

Warnings

The overall input power must not exceed +27dBm

TLTN Installation

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

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

5.7. RF Duplexer, TDPX

Module name:

RF tri-band coupler

TDPX

Description:

TDPX is a frequency dependent duplexer that combines downlink and uplink signals while maintaining isolation and stability.
This board has been designed to support where the source is duplexed.

RF ports

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

TDPX main applications

The TDPX main application is to *connect the duplexed antenna port of the donor source to the Britecell Plus system*. TDPX combines/ /splits the DL and UL signals coming from the donor port into two separated ports

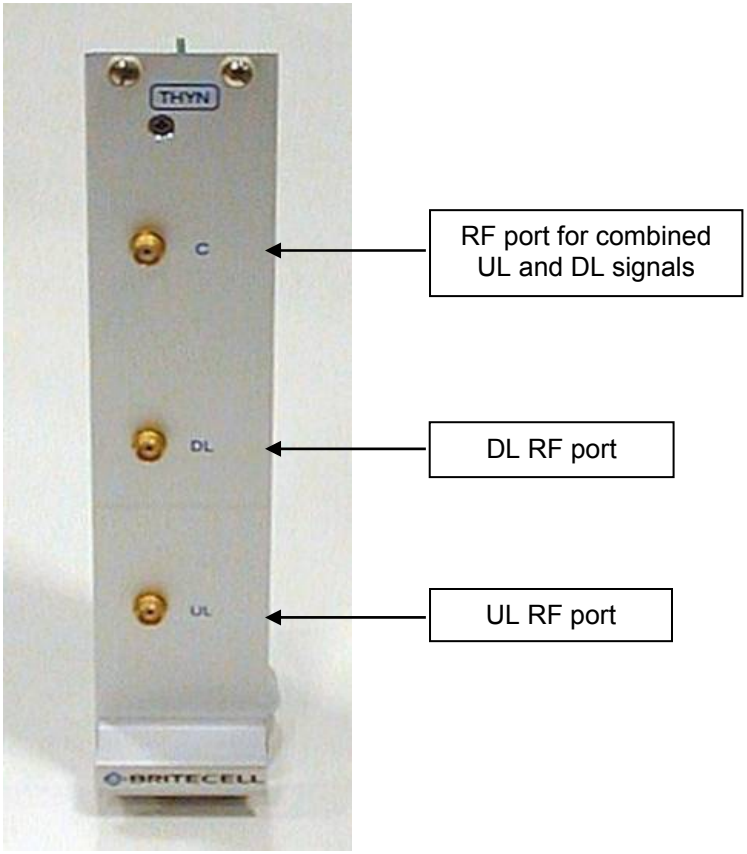


Fig. 5.20: The TDPX duplexer

TDPX insertion loss

The TDPX insertion losses are described in table 5.9.

	UMTS 2100MHz	***All other bands***
TDPX UL insertion loss	2.0 ± 0.5dB	7.0 ± 0.5dB
TDPX DL insertion loss	2.0 ± 0.5dB	3.3 ± 0.5dB

Table 5.9: Insertion loss values of the TDPX module

When designing the system, remember to take into account the insertion losses of the TDPX.

Warnings

The overall input power must not exceed +30dBm.

As the module is band dependent be sure to choose the right single band version.

TDPX Installation

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

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

5.8. Base station Interface TBSI

Module name:

Base station interface

TBSI

Description

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

RF ports

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

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

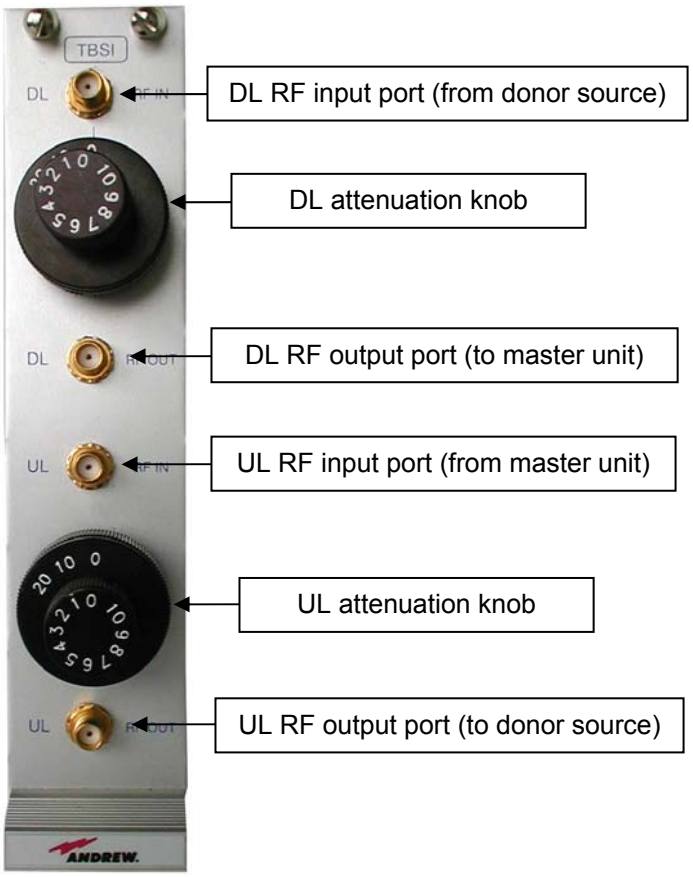


Fig. 5.21: The TBSI base station interface

TBSI main applications

Main applications of the TBSI module are:

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

TBSI insertion loss

The TBSI insertion losses are described in table 5.10:

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

Table 5.10: Insertion loss values of the TBSI module

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

Warnings

The overall input power must not exceed +30dBm

TBSI Installation

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

1. Unpack the kit which include
   - 1 TBSI
   - 2 RF jumpers (SMA-m), 1 x 35cm, 1 x 45cm
2. Carefully insert the TBSI module in any of the TPRN sub-rack slots and lock the 4 screws on the front corners.
3. Connect RF cables according to what planned by designer. Use a specific torque wrench to fix each cable to relevant ports.
4. Set proper attenuation values.

5.9. Power Limiter TMPx-10

Module name:

Power Limiter

TMPx-10

Description

The TMPx-10 power limiter monitors the downlink input power and attenuates it by 10dB above a predetermined set point. The threshold is programmable through the supervision system.
TMPx-10 power limiter is available in two versions, one suitable for GSM DL (800 to 1000MHz or 1800 to 2000MHz) and the other for UMTS 2100MHz DL.

RF ports

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

TMP main applications

Main applications of the TMP module are:

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

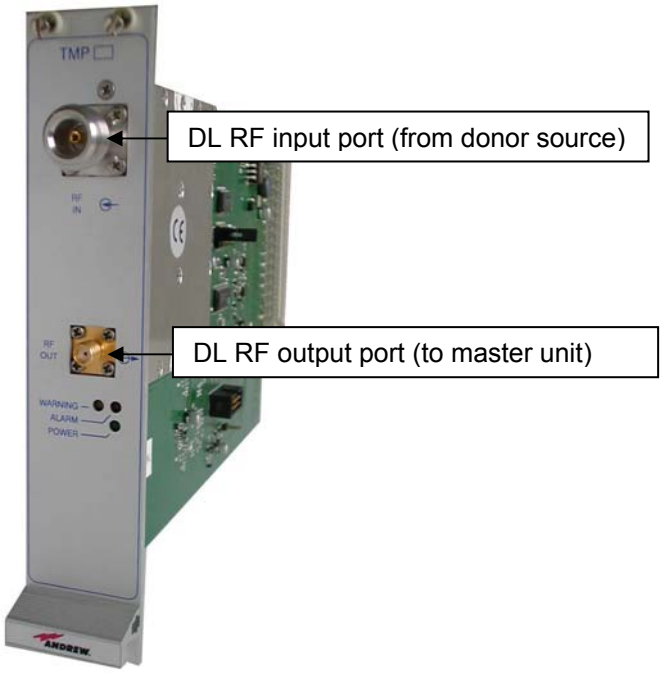


Fig. 5.22: The TBSI base station interface

TMP visual alarms

The TMP front panel is provided with 3 LEDs (see on the right) showing status and alarm information

LED meaning is reported on the rightward table.
Further information about alarm status are delivered by Britecell Plus supervision system

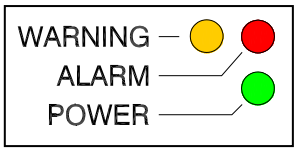


Fig. 5.23: The LED panel on the TMP front-side

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

Tab. 5.11: Summary of TMP LEDs meaning

TMP power supply

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

TMP insertion loss

TMP insertion loss < 1.7dB.

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

Warnings

The overall input power must not exceed +35dBm.

Inserting or removing TMP modules

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

TMP installation

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

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

1. Unpack the kit which include
   - 1 TMP
   - 1 RF jumper (SMA-m), 35cm
2. Carefully insert the TMP module in any of the TPRN sub-rack slots and lock the 4 screws on the front corners.
3. Connect RF cables according to what planned by designer. Use a specific torque wrench to fix each cable to relevant ports.
4. Switch on the sub-rack. As you switch on the system, carefully refer to the TFLN Start-up section.

Removing a TMP module

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

TMP troubleshooting

In case a TMP power limiter has any problem, this will be easily revealed through LEDs on its front panel otherwise troubleshooting can be carried out through LMT or supervision system.

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

Tab. 5.12:Description of the TMP alarms

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

Quick troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 22)

1. In case the TMP red led is on and the green led is off there is a problem on the power supply.
    a. Check the TPRN sub-rack and if it is switched off, switch it on.
    b. If the sub-rack is switched on, check the backplane power supply connector to verify if the +12Vdc is provided to the TMP module. If not there is a fault on the TPRN backplane and you need to return the sub-rack.
    c. Otherwise the TMP power supply section is faulty. Return the unit.
2. In case the TPM red and green leds are on, the RF level at the input port has exceeded the specified threshold. Decrease the RF signal or change the threshold.
3. In case the yellow led is on, check the RF input level

a. If there isn't any RF signal at the input, check if the RF cable is connected at the input port. If it's connected check the power coming out from the donor source.
b. Otherwise the temperature range is not within the specified range, change the temperature range or provide proper air flow.

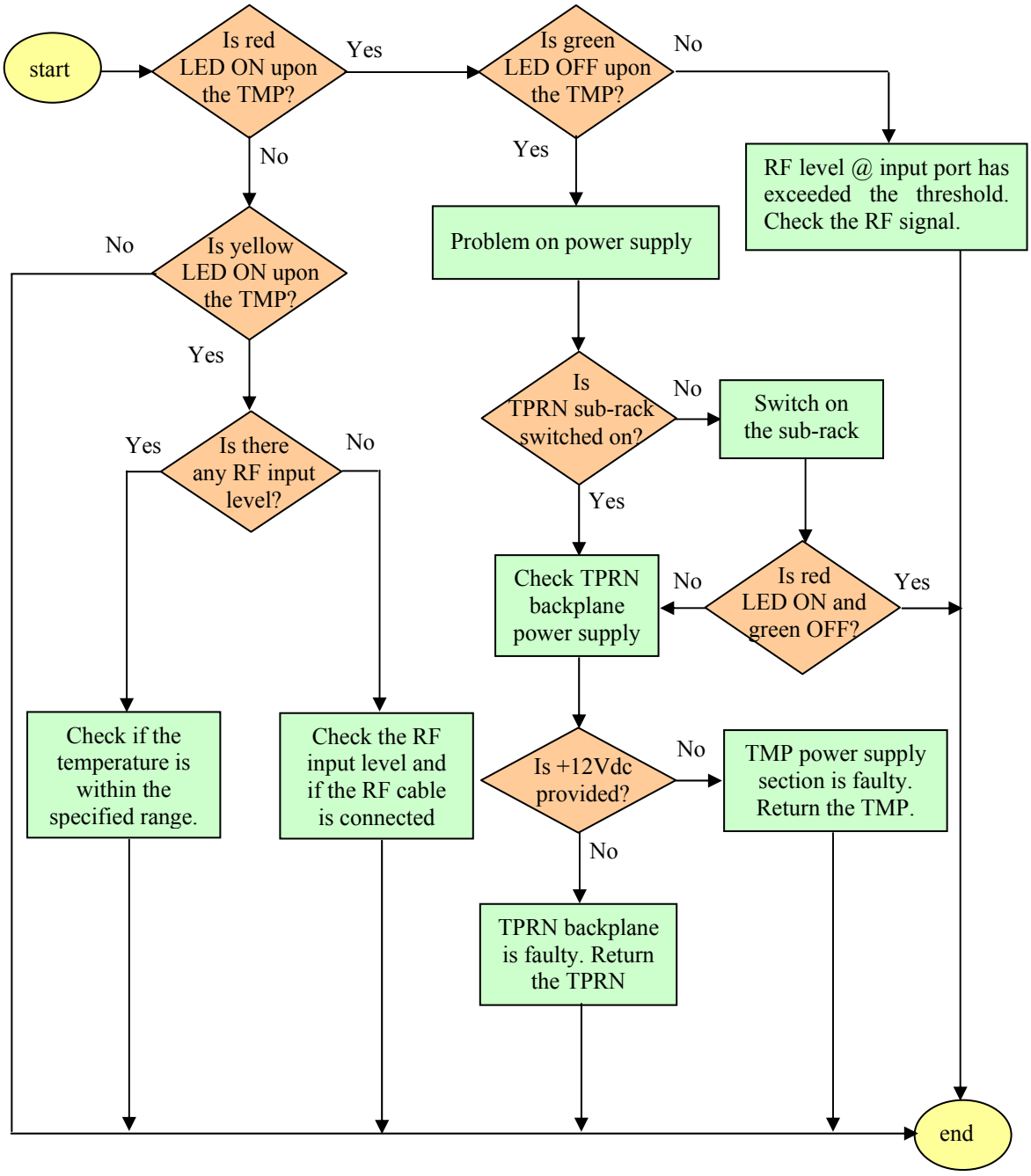


Fig. 5.24: Flow-chart describing the troubleshooting procedure

5.10. Wi-Fi Local Interface, TWLI

Module name:

Wi-Fi Local Interface

TWLI

Description

Britecell Plus system allows distributing WLAN service (802.11b and g) through the auxiliary channel while concentrating all the Access Points together with the central equipment.
The TWLI module allows connecting up to 3 Access Points to one TFLN master optical TRX and setting up to 4dB attenuation, if needed, on the DL path.

RF ports

- 3 DL RF input ports receiving signals from up to 3 different Access Points
- 1 DL RF output port to the TFLN auxiliary port
- 1 UL RF input port from the TFLN auxiliary port
- 3 UL RF output ports sending signals to up to 3 different Access Points

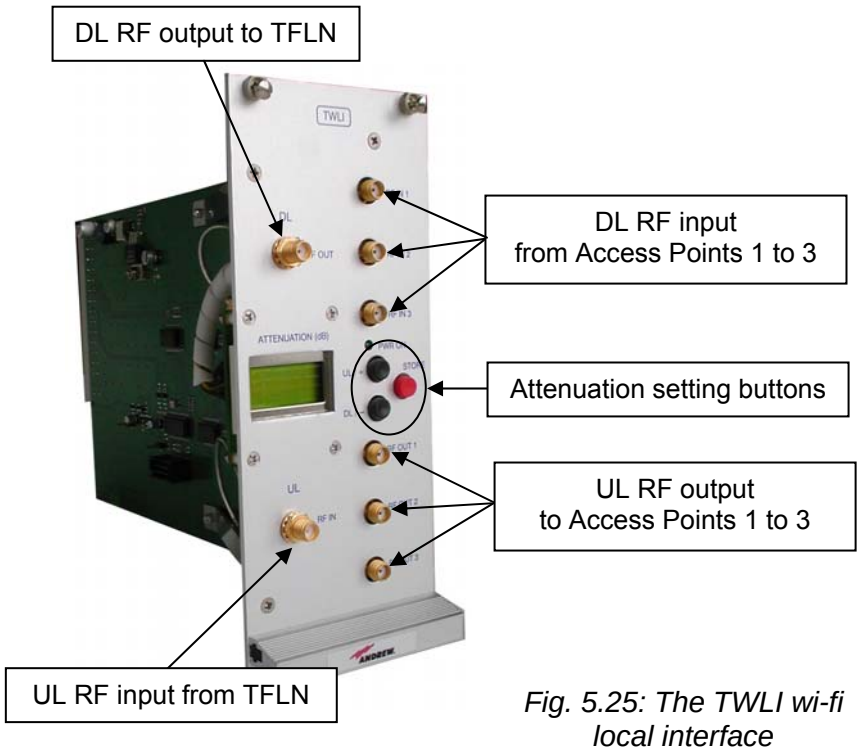


Fig. 5.25: The TWLI wi-fi local interface

4dB attenuation range is available on the DL path in order to adjust levels coming from the Access Points.

TWLI main applications

Main applications of the TWLI module are:

- providing to the TFLN the WLAN signals coming from up to 3 Access Points concentrated on the equipment room.

TWLI power supply

Each TWLI WLAN interface module is supplied by the sub-rack back-plane (+12V).
The power consumption of each TWLI is 2W max.

Warnings

The overall input power must not exceed +19dBm
The TWLI modules must be handled with care, in order to avoid damage to electrostatic sensitive devices.

Inserting or removing TWLI modules

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

TWLI installation

The TWLI WLAN local interface can be accomodated in any of the 12 slots of a TPRN active sub-rack.

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

1. Unpack the kit which include
   - 1 TWLI
   - 2 RF jumpers (SMA-m; SMB-f), 2 x 40cm
2. Carefully insert the TWLI module in any of the TPRN sub-rack slots and lock the 4 screws on the front corners.
3. Connect RF cables according to what planned by designer. Use a specific torque wrench to fix each cable to relevant ports.
4. Switch on the sub-rack. As you switch on the system, carefully refer to the TFLN Start-up section.

Removing a TWLI module

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

5.11. Interconnect Link *(i-link)*

Module name:
Interconnect link
TILx-HL
TILx-HLW

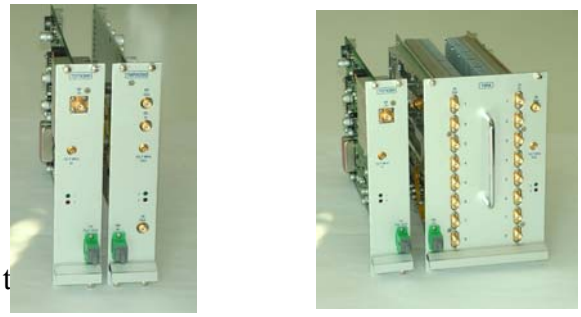
5.11.1. Introduction

the interconnect link is a set of modules which allows to expand the system by connecting a second Britecell Plus subrack station to the main one, at a distance of up to 20 km. By using more interconnect links at the main station, more Britecell Plus stations could be connected to the main one, in a star configuration.

Each interconnect link (i-link) is made up by a master-side and by a slave-side. Both the master side and the slave side are composed by a receiver module and by a transmitter module (please refer to fig. 5.26, 5.27): the transmitter modules are identified by the code TDTX, while the receiver module is identified as TMRX at the master side and as TSRX at the slave side.

The interconnect link is available both in simple version (identified as TILx-HL) and in WDM version (identified as TILx-HLW). A WDM i-link exploits the same fibre to transmit both from master to slave and vice-versa (please refer to fig. 5.28b), while the simple link uses a dedicate fiber for the transmission from master to slave, and a different one for the transmission from slave to master (please refer to fig. 5.28a).

The following four section will describe in details the i-link modules both in WDM and not-WDM version.



(a) (b)

Fig. 5.26: i-link modules: (a) master side; (b) slave-side.

(a) (b)

Fig. 5.27: WDM i-link modules: (a) master side; (b) slave-side.

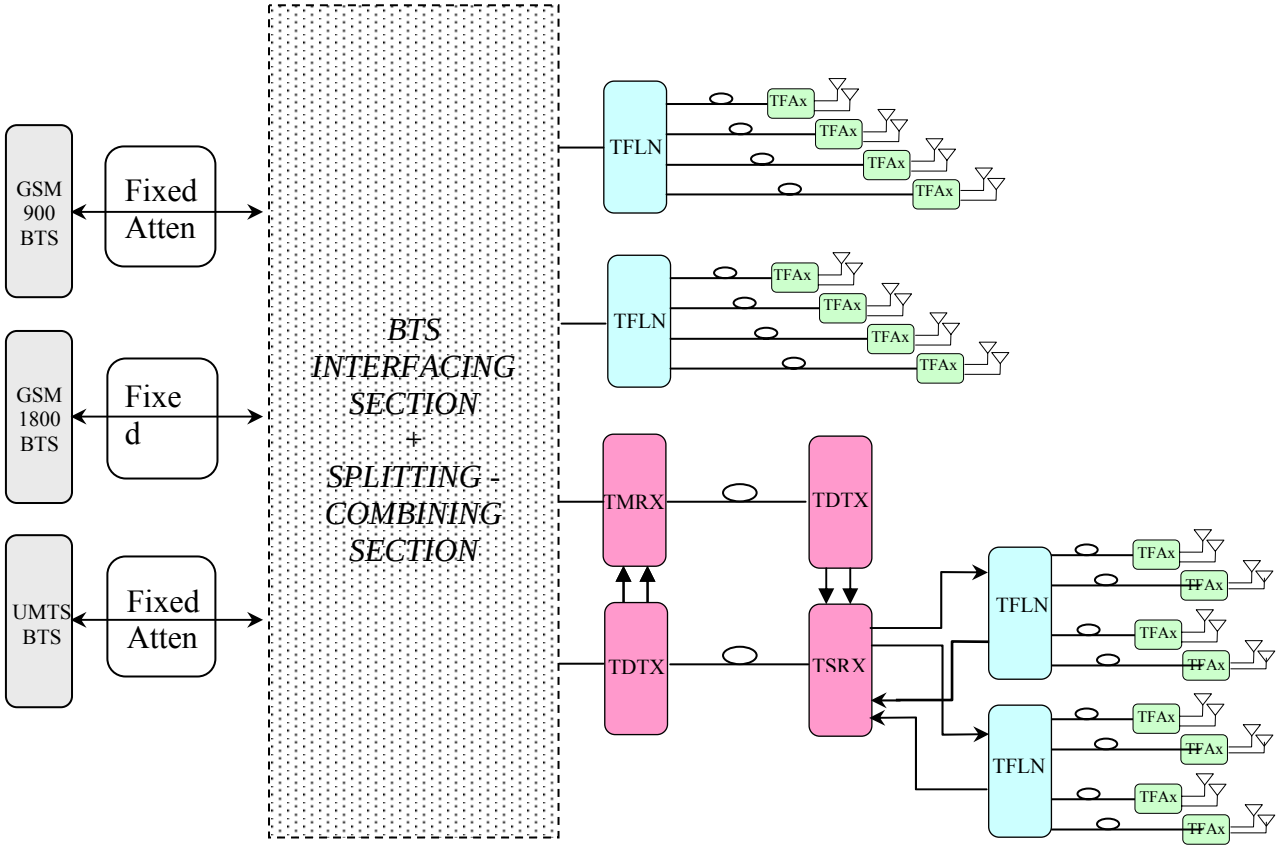


Fig. 5.28(a): Block scheme of a Britecell Plus system with a simple i-link

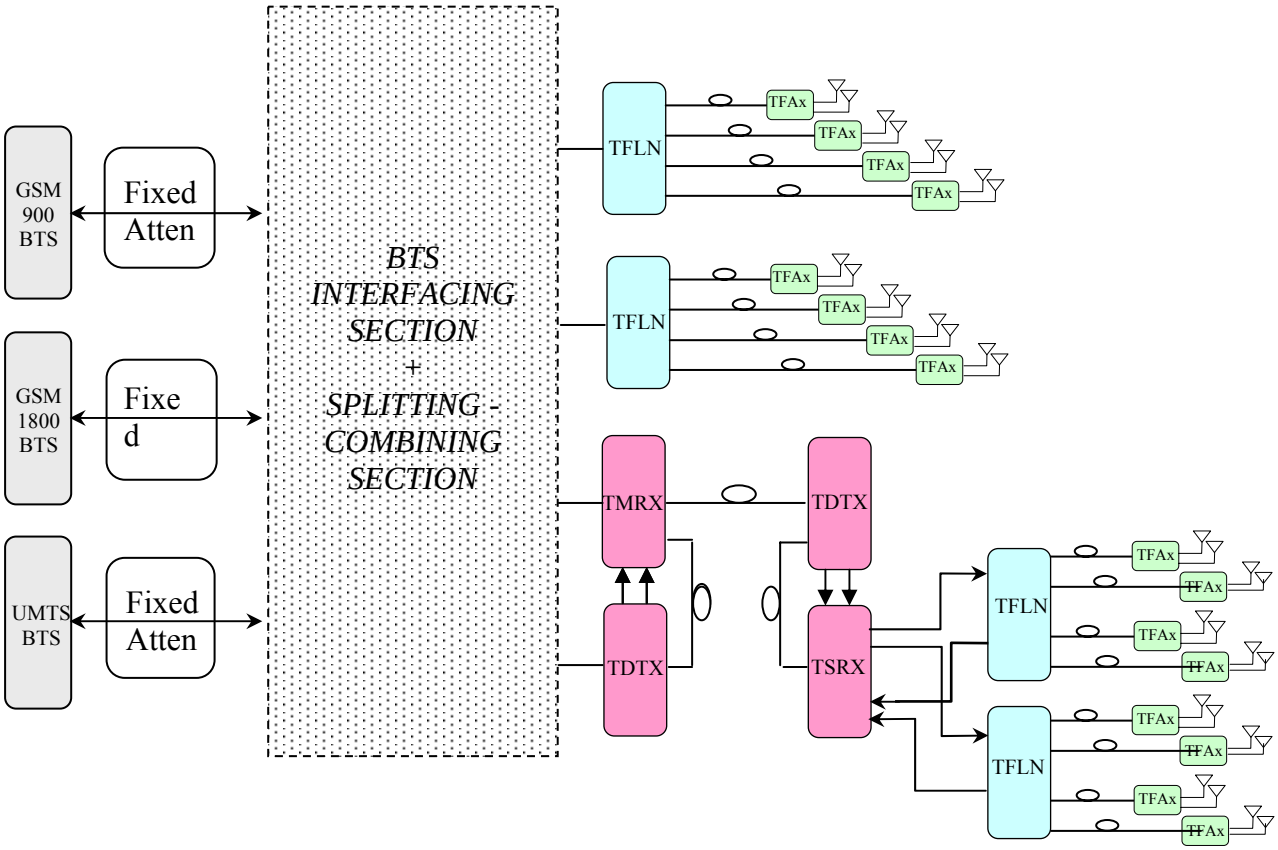


Fig. 5.28(b): Block scheme of a Britecell Plus system with a WDM i-link

5.11.2. TILx-HL i-link

Module description:

The TILx interconnect link is a composite module, made up by a transmitter and a receiver module both on master and on slave side:

- ***Master side***

- TDTX 300 (transmitter module, hosted by 1 subrack slot)
- TMRX 200 (receiver module, hosted by 1 subrack slot)

- ***Slave side***

- TDTX 300 (transmitter module, hosted by 1 subrack slot)
- TSRX 2xx/8 (receiver module, hosted by 3 subrack slots)

The TILx – HL kit is available in *EU tri-band version* (EGSM 900MHz, GSM 1800MHz, UMTS), in *US dual-band version* (SMR 800MHz & Cellular 800MHz, PCS 1900 MHz), and in *hybrid version* (SMR 800MHz & Cellular 800MHz, GSM 1800MHz, UMTS). These versions just differs in the slave-side receiver TSRX module, which is the only module whose features vary with the RF transmitting band.

Block scheme

A scheme of the system, is reported hereinafter, so as describe the connections between the Interconnect-link modules and to give an insight of the function of the modules named above.

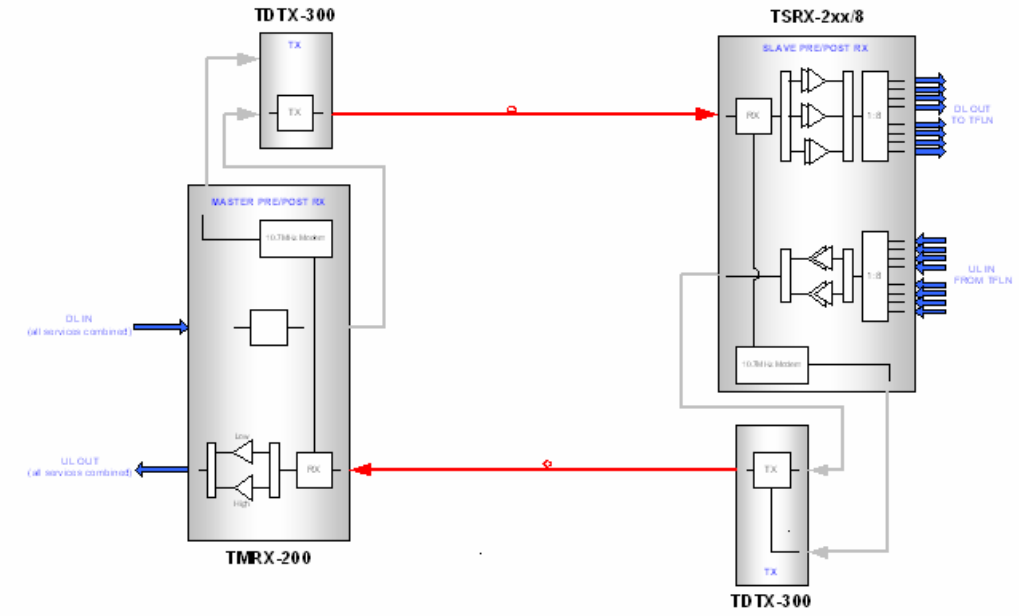


Fig.5.29 – Interconnect link scheme

Main TILx-HL functions:

Downlink:

Master side:

- RF-to-Optical conversion of the signal coming from the splitting/combining section, and transmission to the slave i-link modules via fiberoptics cable;
- Modulation and RF-to-Optical conversion of the bus information, and transmission to the slave i-link modules via fiberoptics cable (on 1310 nm wavelength);

Slave side

- Optical-to-RF conversion of signal and alarm information, with Automatic Gain Control (AGC) in order to compensate the optical losses;
- Distribution of the RF signal to the TFLN optical TRXs, and demodulation of the bus information

Uplink:

Master side:

- Optical-to-RF conversion of signal and alarm information, with Automatic Gain Control (AGC) in order to compensate optical losses
- Distribution of the RF signal to the splitting/combining section, and demodulation of the alarm information

Slave side:

- RF-to-Optical conversion of the signal coming from the TFLN optical TRXs, and transmission to the master i-link modules via fiberoptics cable;
- Modulation and RF-to-Optical conversion of the alarm information, and transmission to the master i-link modules via fiberoptics cable (on 1310 nm wavelength);

TILx-HL Master Side: TDTX300 transmitter + TMRX200 receiver

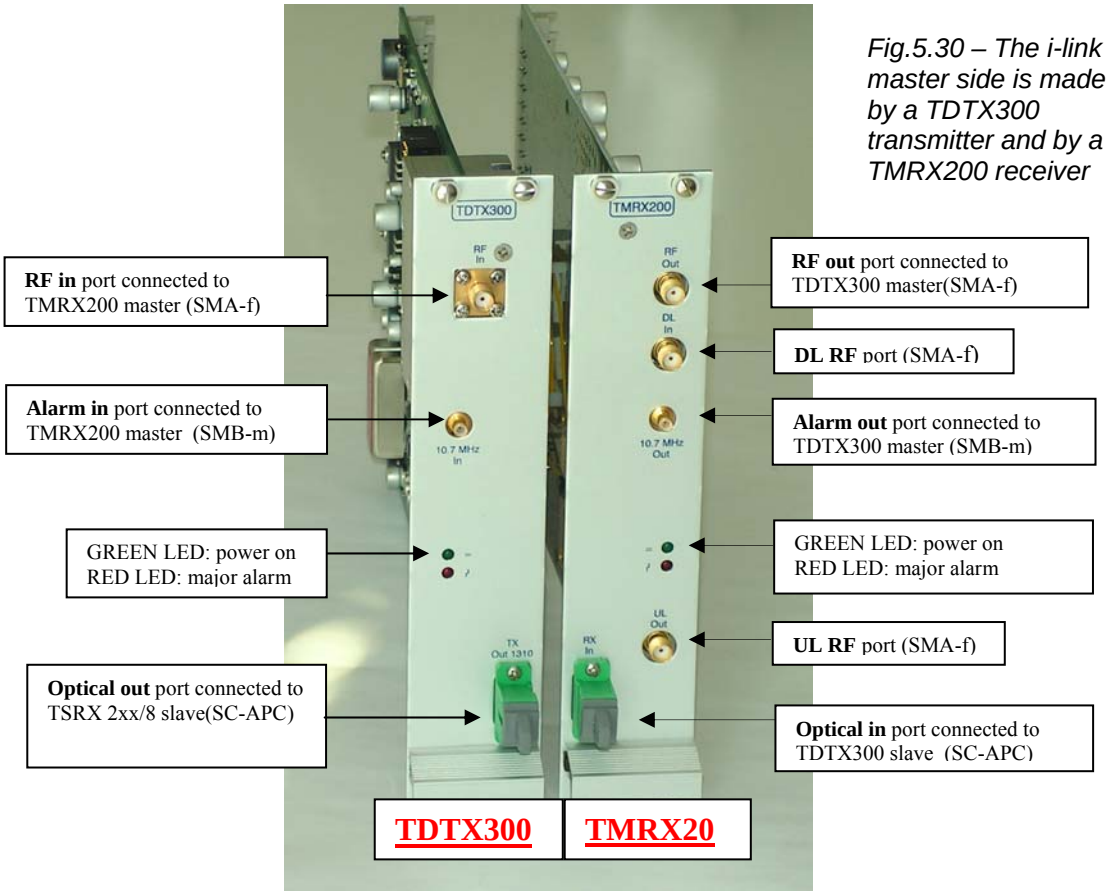


Fig.5.30 – The i-link master side is made up by a TDTX300 transmitter and by a TMRX200 receiver

TILx – HL Master-side: *RF ports*

TDTX300 transmitter:

- 1 RF input port , to be connected directly to the RF output port of the TMRX200 adjacent module
- 1 alarm input port, to be connected directly to the alarm output port of the TMRX200 adjacent module

TMRX200 receiver:

- 1 RF output port, to be connected directly to the RF input port of the TDTX300 adjacent module
- 1 alarm output port, to be connected directly to the alarm input port of the TDTX300 adjacent module
- 1 RF DL port, sent to the passive devices which interface the Britecell with the BTS
- 1 RF UL port, coming from the passive devices which interface the Britecell with the BTS

TILx – HL Master-side: *Optical ports*

T DTX300 transmitter:

- 1 Optical output port, to be connected directly to the optical input port of the slave-side TSRX2xx/8 receiver

TMRX200 receiver:

- 1 Optical input port, to be connected directly to the optical output port of the slave-side TDTX300 transmitter

TILx – HL Master-side: *LED Alarms*

TDTX300 transmitter: Two control LEDs (one green, one red) are placed on the TDTX300 front panel. The green LED describes the power supply status of the TDTX module, while the red LED describes the major TDTX failure (please refer to table 5.13)

TMRX200 receiver:

Two control LEDs (one green, one red) are placed on the TMRX200 front panel. The green LED describes the power supply status of the TDTX module, while the red LED describes the major TMRX failure (please refer to table 5.14)

Led colour	*Meaning*
Red	Optical power failure, wavelength out of range, power supply failure
Green	Power supply OK

Table 5.13: Summary of master TDTX300 LEDs meaning

Led colour	*Meaning*
Red	Power supply failure, modem failure, RF UL failure, AGC compensation failure
Green	Power supply OK

Table 5.14: Summary of TMRX200 LEDs meaning

TILx - HL Slave-Side: TDTX300 transmitter + TSRX2xx/8 receiver

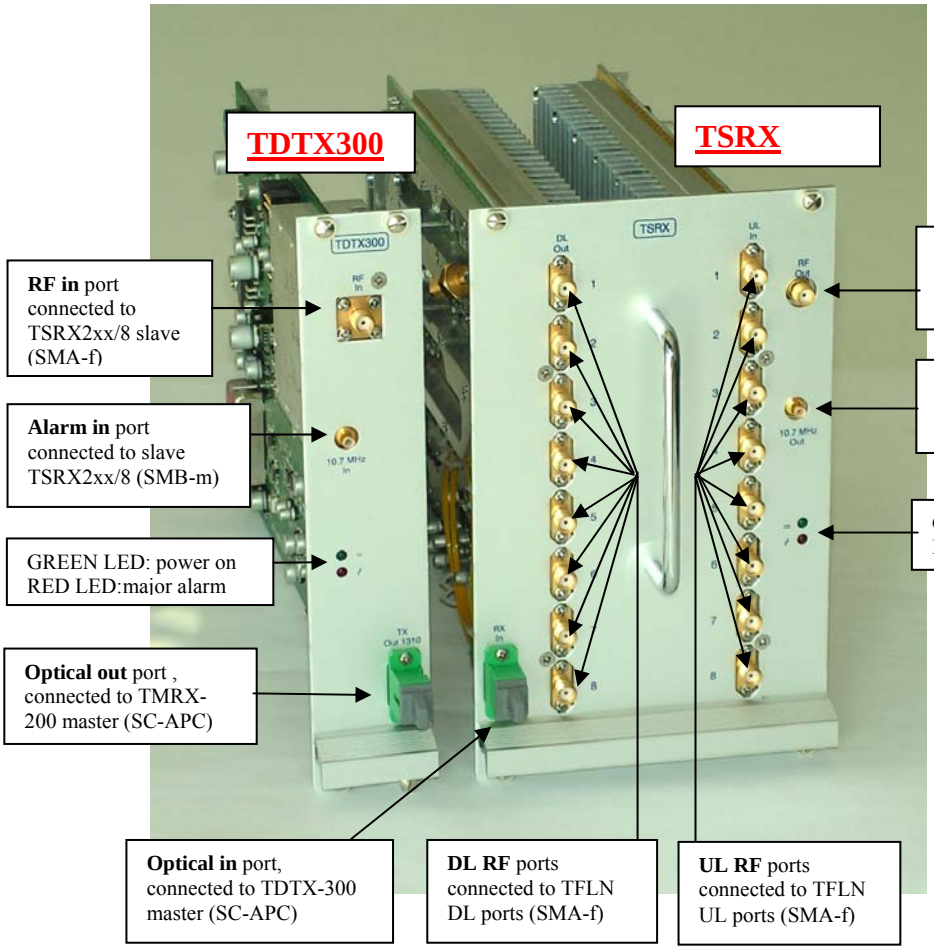


Fig.5.31 – The i-link master side is made up by a TDTX300 transmitter and by a TMRX200 receiver

TILx – HL Slave-side: *RF ports*

TDTX300 transmitter:

- 1 RF input port , to be connected directly to the RF output port of the TSRX2xx/8 adjacent module
- 1 alarm input port, to be connected directly to the alarm output port of the TSRX2xx/8 adjacent module

TSRX2xx/8 receiver

- 1 RF output port, to be connected directly to the RF input port of the TDTX300 adjacent module
- 1 alarm output port, to be connected directly to the alarm input port of the TDTX300 adjacent module
- 8 RF DL ports, which can feed up to 8 TFLN local transmitters ;
- 8 RF UL ports, which can receive the UL signals from up to 8 TFLN local transmitters.

TILx -HL Slave-side: *Optical ports*

TDTX 300 transmitter:

- 1 Optical output port, to be connected directly to the optical input port of the master-side TMRX200 receiver

TSRX2xx/8 receiver:

- 1 Optical input port, to be connected directly to the optical output port of the master-side TDTX300 transmitter

TILx – HL Slave-side: *LED Alarms*

TDTX300 transmitter: Two control LEDs (one green, one red) are placed on the TDTX300 front panel. The green LED describes the power supply status of the TDTX module, while the red LED describes the major TDTX failure.

TSRX2xx/8 receiver: Two control LEDs (one green, one red) are placed on the TSRX2xx/8 front panel. The green LED describes the power supply status of the TSRX module, while the red LED describes the major TSRX failure.

Led colour	*Meaning*
Red	Optical power failure, wavelength out of range, power supply failure
Green	Power supply OK

Table 5.15: Summary of slave TDTX300 LEDs meaning

Led colour	*Meaning*
Red	Power supply failure, modem failure, RF UL and DL failure, AGC compensation failure
Green	Power supply OK

Table 5.16: Summary of TSRX2xx/8 LEDs meaning

Warnings (to be read before the TILx – HL installation)

Dealing with optical output ports

- The TDTX modules (both on master and on slave side) contain 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

Inserting or removing TDTX, TMRX, TSRX modules

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

Placing the TILx -HL modules inside the subrack

- The i-link modules at slave side should be installed in the middle of the slave subrack, or at least they should have no more than 4 TFLN modules both on the right side and on the left side of the TSRX 2xx/8 module. This requirement is advised in order to allow connection between the TSRX module and all the TFLN transmitters (see fig. 5.33)

TILx – HL installation

Master Cable Installation Kit:

- 1 SMA-Male/SMA-Male RF jumpers
- 1 SMB-Female/SMB-Female RF jumper

Slave Cable Installation Kit:

- 17 SMA-Male/SMA-Male RF jumpers
- 1 SMB-Female/SMB-Female RF jumper

Both on master side and on slave side, the i-link modules are to be housed into a TPRN active sub-rack.

On the master-side station, the i-link modules are to be housed into 2 adjiacent slots, chosen among the 12 available ones in the subrack.
On the slave-side subrack, the i-link modules are to be housed into 4 adjiacent slots: moreover, due to the particular cabling they require, these 4 adjiacent slots should be placed in mid-subrack, so that no more than 4 TFLN local units stay on each side of the i-link modules (as shown in fig. 5.33).

Note: If the i-link modules are to be installed in an already working Master Unit, switch off the sub-racks before inserting the modules.

Before inserting the boards into the TPRNx4 subracks, make sure to set proper RS485 addresses. A basic rule of the Britecell installation is that 2 subracks belonging to the same Master Unit should always have different RS485 addresses (please refer to "TPRN Installation" section): since the interconnect-link basically provides an extension of the Master Unit bus, any subrack on the i-link master-side should also have a RS485 address different from any subrack on the i-link slave side.
Please refer to "TPRNx4 Installation" section for more information on setting the RS485 address.

Firstly, carefully insert the TMRX200 and the TDTX300 boards in 2 adjacent slots of the Master side subrack. Lock the 4 screws on the corners of each boards.
Use the provided SMA-m RF jumper in order to connect the RF Out Port of the TMRX200 module to the RF In Port of the adjacent TDTX300 module. Use the SMB-f jumper to connect the 10.7MHz ports of the two boards. Fix these RF jumpers to the RF ports through a proper torque wrench (not included).
Remove the protection cap from the optical ports of the 2 modules on the master side.
Take a SC-APC fiber, clean the fibre termination, and connect it to the optical

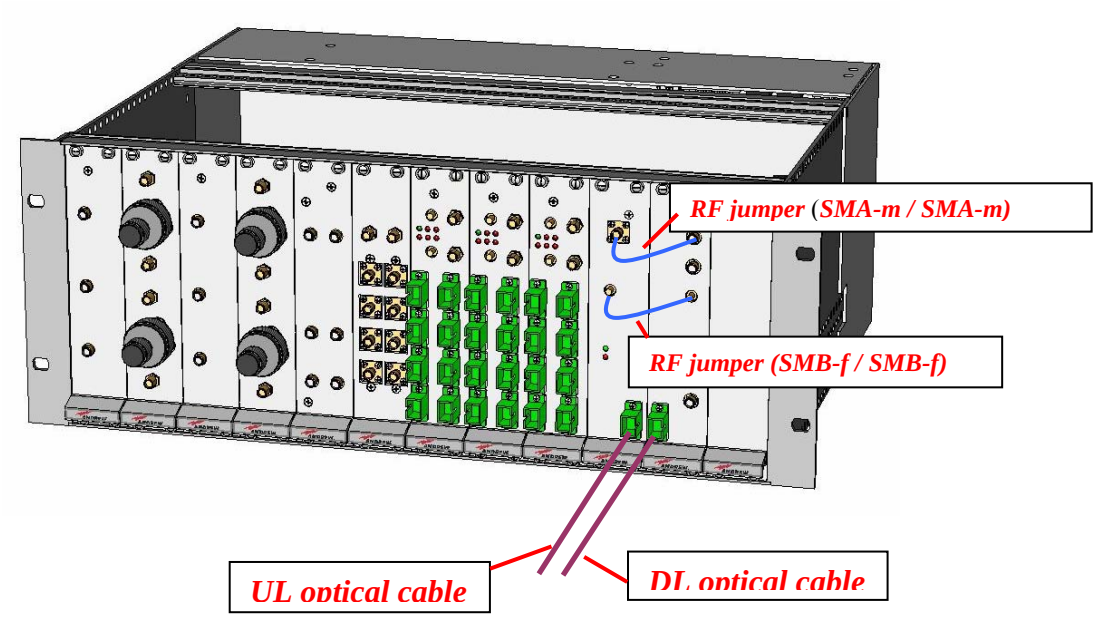


Fig. 5.32: TILx-HL master side

out port of the master-side TDTX300 module. *(This fiber shall be directly connected to the optical in port of the TSRX2xx/8 module on the slave-side subrack)*
Take a SC-APC fiber, clean the fibre termination, and connect it to the optical in port of the TMRX200 module *(This fiber shall be directly connected to the optical out port of the TDTX300 on the slave-side subrack)*

Carefully insert the TSRX2xx/8 and the TDTX300 boards in 4 adjacent slots of the Master side subrack. As already explained, take care not to have more than 4 TFLN modules on each side of the i-link pieces. Lock the 4 screws on the corners of each boards.
Use the provided SMA-m RF jumper in order to connect the RF Out Port of the TSRX2xx/8 module to the RF In Port of the adjacent TDTX300 module. Use the SMB-f jumper to connect the 10.7MHz ports of the two boards.
Use the longer RF jumpers (included) to connect each pair of TSRX UL and DL ports to the corresponding UL and DL ports of each TFLN module mounted on slave-side subrack. If less than 8 TFLNs are used at slave-side, make sure to mask the TSRX-2xx/8 unused DL and UL ports by SMA loads (not provided).

Remove the protection cap from the optical ports of the 2 modules on the slave side.
Take a SC-APC fibre, clean the fibre termination, and connect it to the optical out port of the master-side TDTX300 module. This fiber has to be directly connected to the optical in port of the TMRX200 module of the master-side subrack. Use a specific torque wrench to fix the RF cables to the RF ports.
Take a SC-APC fiber, clean the fibre termination, and connect it to the optical in port of the TSRX200 module. This fiber has to be directly connected to the optical out port of the TDTX300 on the master-side subrack.

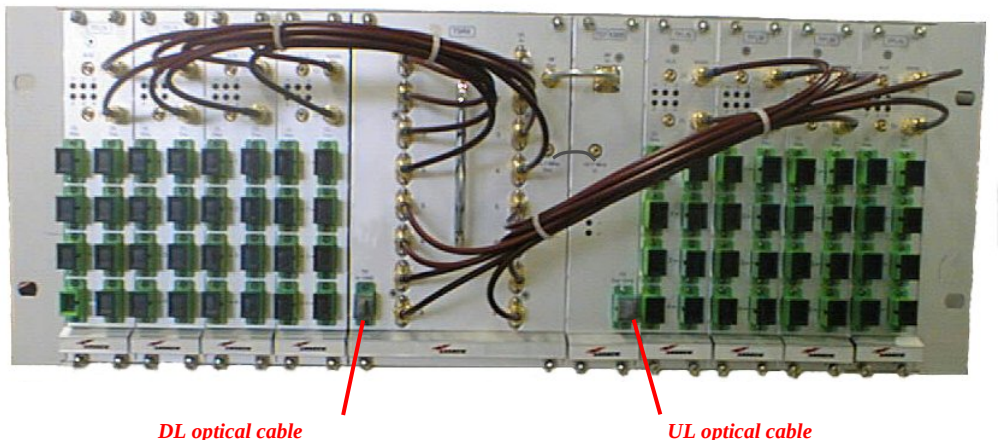


Fig. 5.33: TILx-HL slave side

As you switch on the system, carefully refer to the "TILx-HL start-up" section.

Removing a TILx - HL module

To remove an i-link module, firstly switch off the TPRNx4 subrack which houses the module.

Remove the fibers and the RF jumpers connected to the i-link module which is going to be removed. Insert the caps on the optical ports which has just been disconnected.

Unscrew the 4 screws at the corners of the i-link module which is going to removed, and slowly remove the card.

TILx--HL

Put the card in its safety box

TILx – HL start-up

Before both the master-side station and the slave-side station(s) are switched on, make sure that:

- all expected modules have been inserted into the Master Unit
- the modules have been connected each other by RF jumpers, according to what planned in the system design
- the i-link master modules have been connected to the relevant slave side modules through fiberoptics cables;
- every TFLN master optical TRX has been connected to relevant remote units
- each remote unit has been connected to its coverage antennas
- the remote supervision unit, if present, has been connected to the Master Unit
- both on the master-side and on slave-side stations, the different subracks are connected each other via bus RS485

After that, remember that all remote units have to be switched on before the master-side and the slave-side subracks. When all the remote units are on, the different subracks (at master-side and slave-side) can be switched on. Once all the active subracks have been switched on, the behaviour of the different i-link modules can be summarized as follows:

- All the LEDs on the different i-link modules (both on master side and on slave side) turn on for a couple of seconds;
- After that, all the green LEDs on the different modules remain ON (thus indicating proper power supply), while the red LEDs switch off as soon as the master-side and the slave-side detect each other;
- During normal working operations, the LEDs on the front panels of the TILx modules should behave according to what described in table 5.13, 5.14, 5.15, 5.16;
- Once all the master-side and slave-side subracks have been switched on, the system should begin to work correctly. Anyway, in order that the i-link modules are recognized by the supervision management system, it is necessary that the system carries 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 LEDs ┌┘ blink. **Do not connect / disconnect any cable or any piece of equipment during the discovery phase!** This may result in failing the identification of some equipment.

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).

- Finally, please note that the receiver module TSRX2xx/8 has only one connection with the subrack backplane, so that the LMT software and the supervision system will detect it as a 1-slot card. More in details, only the slot which hosts the TSRX LED alarms is recognized by LMT or supervision. The other 2 slots hosting the TSRX receiver are therefore to be masked through the LMT or the Supervision System Interface (please refer to the relevant user manuals) in order to avoid fictitious alarm notifications.

TILx – HL troubleshooting

Faults on the i-link modules can be revealed:
- by LEDs on the front panels of the modules themselves
- by the LMT software running on a PC connected to a master side or a slave-side subrack via RS232 port;
- by the supervision system interface managed by the remote supervision unit, usually placed conveniently on the master-side.

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.
The tables 5.17, 5.18, 5.19 reports a brief description of alarm related to the different i-link modules, together with a reference to corresponding alerted LEDs and to possible recovery actions.

As shown by these tables, the LEDs show only the alarms concerning the board where they are housed: so, a red LED which is switched on at TSRX front side reveals an alarm affecting the TSRX module itself (it does not deals with the alarms affecting the other module of the i-link slave-side, which is an TDTX300, and whose alarms will be detected by its own LEDs). Moreover, these tables show that the LEDs reveals only major alarms, 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 possibile system faults.
Although any alarm detected by a LED on the i-link modules should be verified through LMT or supervision software when an accurate check is needed, some ordinary maintenance procedures could be carried out quickly following the instructions described hereinafter

TDTX 300 (master side or slave side)					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Vcc alarm	There is a degradation on the power supply provided by the backplane	RED	MAJOR	Return the unit	MAJOR
Optical power <1dB	The received optical power experiences a degradation which is near to the AGC working threshold (but it can still compensate losses)	NONE	MINOR	Check the optical loss / AGC status on the TSRX or TMRX module at the other side of the imterconnect link	MINOR
Optical power <3dB	The transmitted optical power experiences a degradation which can no more be compensated by the AGC.	RED	MINOR	Return the unit	MAJOR
Temperature Alarm	Over-temperature alarm (lower than 0° C or higher than 65° C)	NONE	WARNING	Check the subracks ventilation; verify the environmental conditions involving heating and air circulation	MINOR

Table 5.17: Description of TDTX300 alarms, as they are described by the LMT software or by the suspervision interface

TMRX 200					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Power supply alarm	There is a degradation in power supply distribution	RED	MAJOR	Return the unit	MAJOR
RX1 AGC out of range	The received optical power experiences a degradation which is near to the AGC working threshold (but it can still compensate losses)	NONE	WARNING	Check the optical loss / AGC status on the TSRX or TMRX module at the other side of the imterconnect link	MINOR
RX1 Optical power fail	The transmitted optical power experiences a degradation which can no more be compensated by the AGC	RED	MAJOR	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	WARNING	Check the subrack and cabinet ventilation, verify the environmental conditions involving heating and air circulation	MINOR
FSK modem alarm	HW problem on the 10.7 MHz FSK modem	RED	CRITICAL	Return the unit	MAJOR
UL RF alarm	UL hardware failure	RED	MAJOR	Return the unit	MAJOR
Current Fail	Overcurrent alarm	RED	MAJOR	Return the unit	MAJOR

Table 5.18: Description of TMRX200 alarms, as they are described by the LMT software or by the suspervision interface

TSRX 2xx/8					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Power supply alarm	There is a degradation in power supply distribution	RED	MAJOR	Return the unit	MAJOR
RX1 AGC out of range	The received optical power experiences a degradation which is near to the AGC working threshold (but it can still compensate losses)	NONE	WARNING	Check the optical loss / AGC status on the TSRX or TMRX module at the other side of the interconnect link	MINOR
RX1 Optical power fail	The transmitted optical power experiences a degradation which can no more be compensated by the AGC	RED	MAJOR	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	WARNING	Check the subrack and cabinet ventilation, verify the environmental conditions involving heating and air circulation	MINOR
FSK modem alarm	HW problem on the 10.7 MHz FSK modulator/demodulator	RED	CRITICAL	Return the unit	MAJOR
DL Low band RF alarm	HW failure on the DL RF low band	RED	CRITICAL	Return the unit	MAJOR
DL High band RF alarm	HW failure on the DL RF high band	RED	CRITICAL	Return the unit	MAJOR
DL UMTS RF alarm *(only on TSRX 247/8 version)*	HW failure on the DL RF UMTS band	RED	CRITICAL	Return the unit	MAJOR
UL Low-band RF Alarm	HW failure on the UL RF low band	RED	CRITICAL	Return the unit	MAJOR
UL High-band RF Alarm	HW failure on the UL RF high band	RED	CRITICAL	Return the unit	MAJOR
UL UMTS RF alarm *(only on TSRX 247/8 version)*	HW failure on the UL UMTS band	RED	CRITICAL	Return the unit	MAJOR
Current Fail	Overcurrent alarm	RED	MAJOR	Return the unit	MAJOR

Table 5.19: Description of TSRX2xx/8 alarms, as they are described by the LMT software or by the suspervision interface

TDTX-300 module troubleshooting

The TDTX module is an optical transmitter whose alarm status cannot be influenced by dirt optical adapters or by some problems in fiberoptics cables towards the opposite i-link side. If the red light is switched on in the TDTX front panel, please check if you have connected properly the

RF jumper. If the RF connection proves to be ok and the red LED keep on switching on, please contact the manufacturer.

TMRX-200 module troubleshooting

Ordinary troubleshooting procedures which can be carried out on TMRX-200 module first involve a check of the optical adapter status and of the fiberoptics cable. If the alarm status still persists, a reboot of both the TMRX-200 module and of the TSRX-2xx/8 module can be performed so as to re-inizialize the link.

Quick TMRX-200 troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 5.34a)
In case the red LED is ON, please follow these steps:

1. Clean the optical adapter
2. If the problem still persists, refer to the TMRX/TSRX fiber optic troubleshooting so as to check if the optical cable or optical connection has any problem on DL path
3. If previous actions didn't make the LED switch off, a reboot of both the TMRX-200 module and of the TSRX-2xx/8 module (on the slave-side) could be performed so as to re-inizialize the link.
4. If the red LED still remains on, please check the alarm status by the LMT or the supervision unit in order to better understand the problem and its possible solution.

TMRX/TSRX fiber optic troubleshooting

(The following procedure is summarized by the flow-chart in fig. 5.34b)

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 TMRX (TSRX) 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 more firmly the SC-SPC connectors to their adapters. If the TMRX (TSRX) 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 also the relevant SC-APC adapters. Re-connect the fibre to relevant ports after cleaning. If it doesn't make TMRX (TSRX) red LED switch off, follow next steps.
4. Disconnect the fiber from the TMRX (TSRX) port, and measure the power Pout which comes out from the fiber. Then, go to the module where the other end of the fiber is connected (it can be either on the slave side and on the master side, depending on the fiber or on the jumper you are verifying), disconnect it and measure the input power Pin coming out of the port. Calculate the fibre attenuation A due to the fiberoptics cable: Af [dB] = Pin – Pout
   a. If ADL > 10 dB, then the fibre optic cable has some problems. Replace it with a new one.
   b. If ADL < 10 dB troubleshooting procedure has not identified the problem. Refer to supervision system or contact the manufacturer for assistance.

TSRX-2xx/8 module troubleshooting

Ordinary troubleshooting procedures which can be carried out on TMRX-200 module first involve a check of the optical adapters status and of the fiberoptics cables. If the alarm status still persists, a reboot of both the TMRX-200 module and of the TSRX-2xx/8 module can be performed so as to verify if the problem depends on a failed modem connectivity.

Quick TSRX-2xx/8 troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 5.34c)
In case the red LED is ON, please follow these steps:

1. Clean the optical adapter
2. If the problem still persists, refer to the fibre optic DL troubleshooting so as to check if the optical cable or optical connection has any problem on DL path
3. If previous actions didn't make the LED switch off, a reboot of both the TSRX-2xx/8 module and of the TMRX-200 module (on the master side) could be performed so as to test modem connectivity.
4. If the red LED still remains on, please check the alarm status by the LMT or the supervision unit in order to better understand the problem and its possible solution.

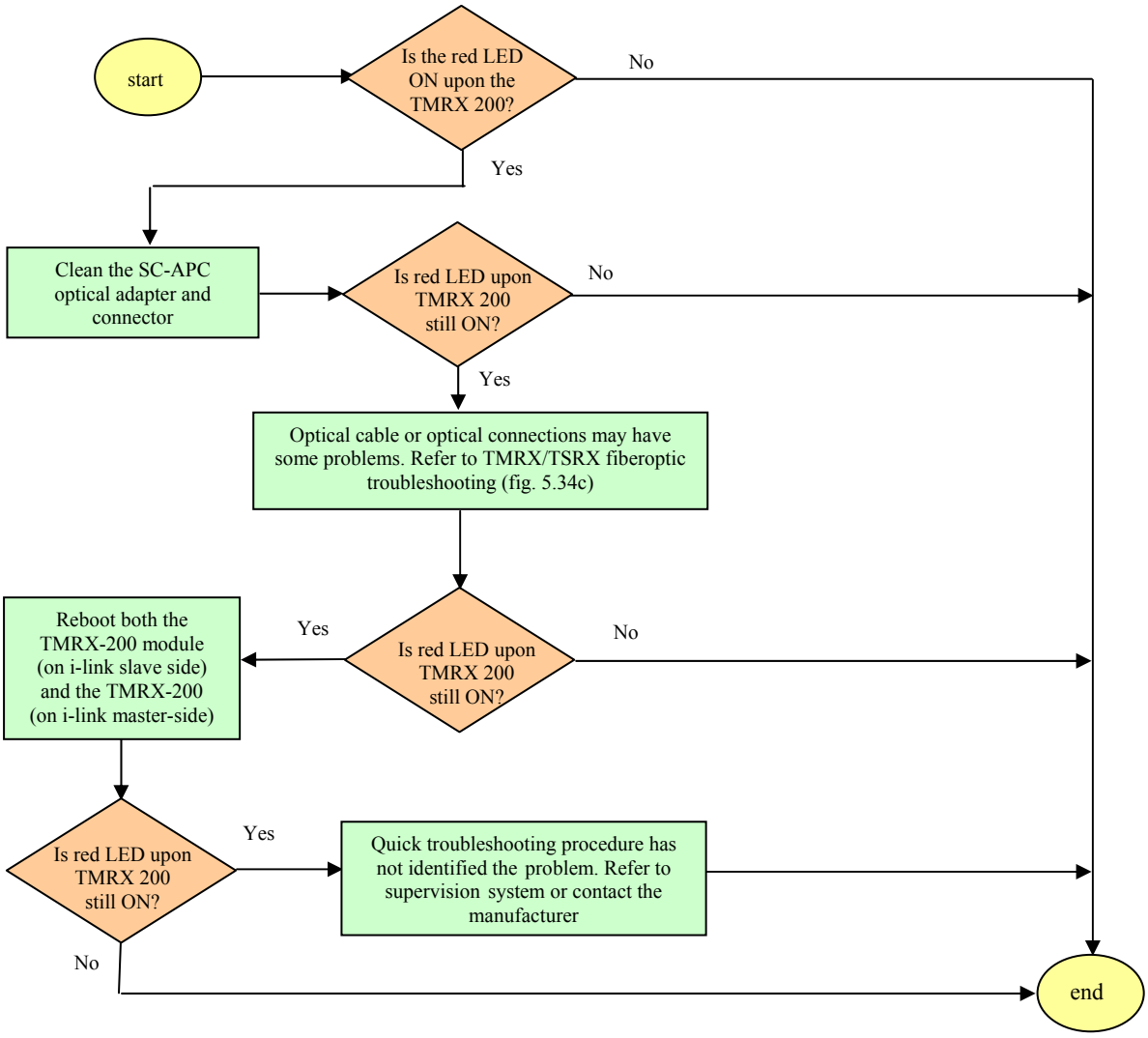


Fig. 5.34(a): Flow-chart describing the quick TMRX200 troubleshooting.

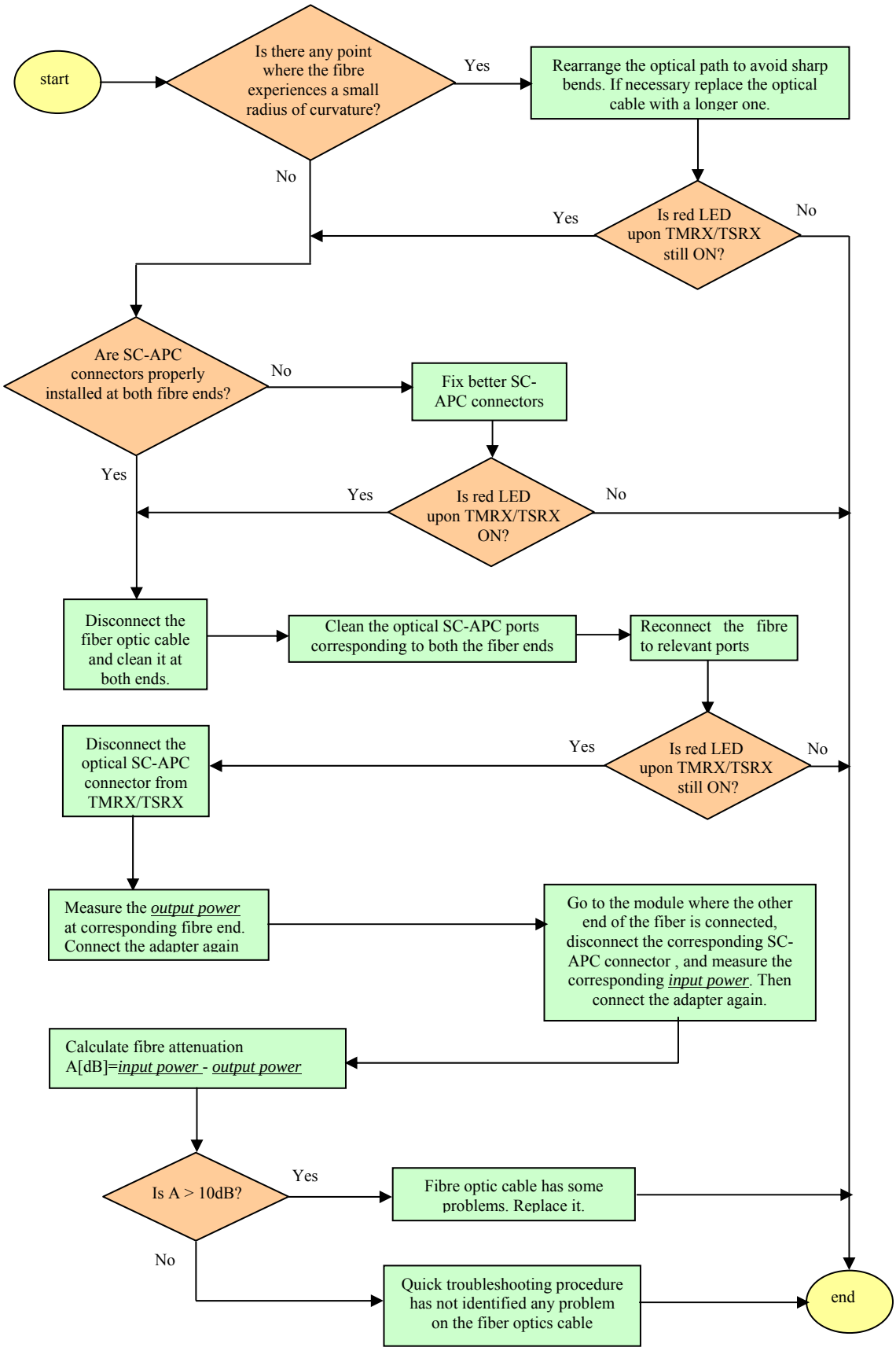


Fig. 5.34(b): Flow-chart describing the TMRX/TSRX fiberoptic troubleshooting.

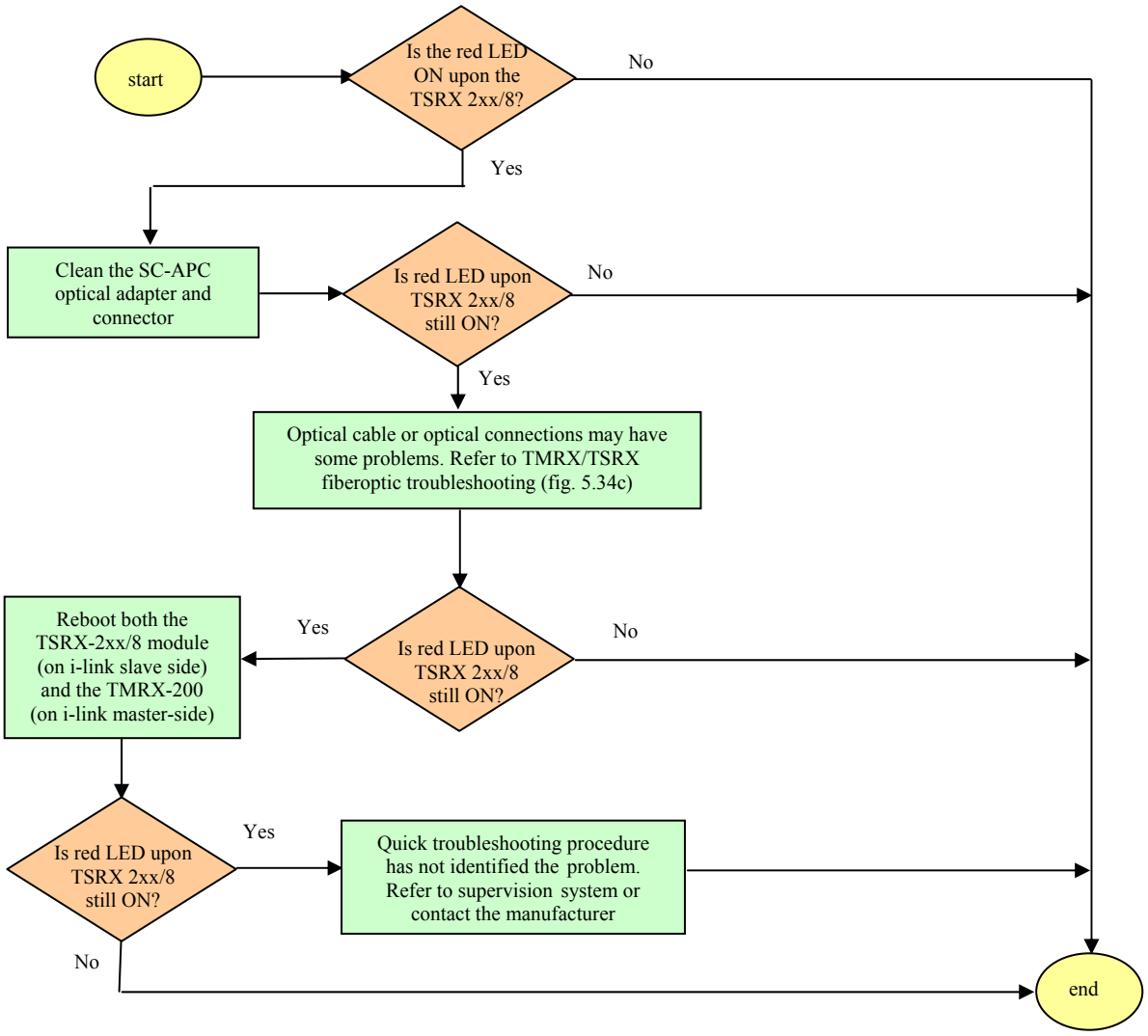


Fig. 5.34(c): Flow-chart describing the quick TSRX2xx/8 troubleshooting.

5.11.3. TILx-HLW i-link

Module name:

WDM interconnect link

TILx-HLW

Module description:

The WDM interconnect link is a composite module, made up by a transmitter and a receiver module both on master and on slave side:

- ***Master side***

-TDTX-300 (transmitter module, hosted by 1 subrack slot)
-TMRX-500 (receiver module, hosted by 1 subrack slot)

- ***Slave side***

-TDTX-500 (transmitter module, hosted by 1 subrack slot)
-TMRX-3xx/8 (receiver module, hosted by 3 subrack slots)

The TILx – HLW kit is available in *EU tri-band version* (EGSM 900MHz, GSM 1800MHz, UMTS), in *US dual-band version* (SMR 800MHz & Cellular 800MHz, PCS 1900 MHz), and in *hybrid version* (SMR 800MHz & Cellular 800MHz, GSM 1800MHz, UMTS). These versions just differs in the slave-side receiver TSRX module, which is the only module whose features vary with the RF transmitting band.

Block scheme

A scheme of the system, is reported hereinafter, so as describe the connections between the Interconnect-link modules and to give an insight of the function of the modules named above.

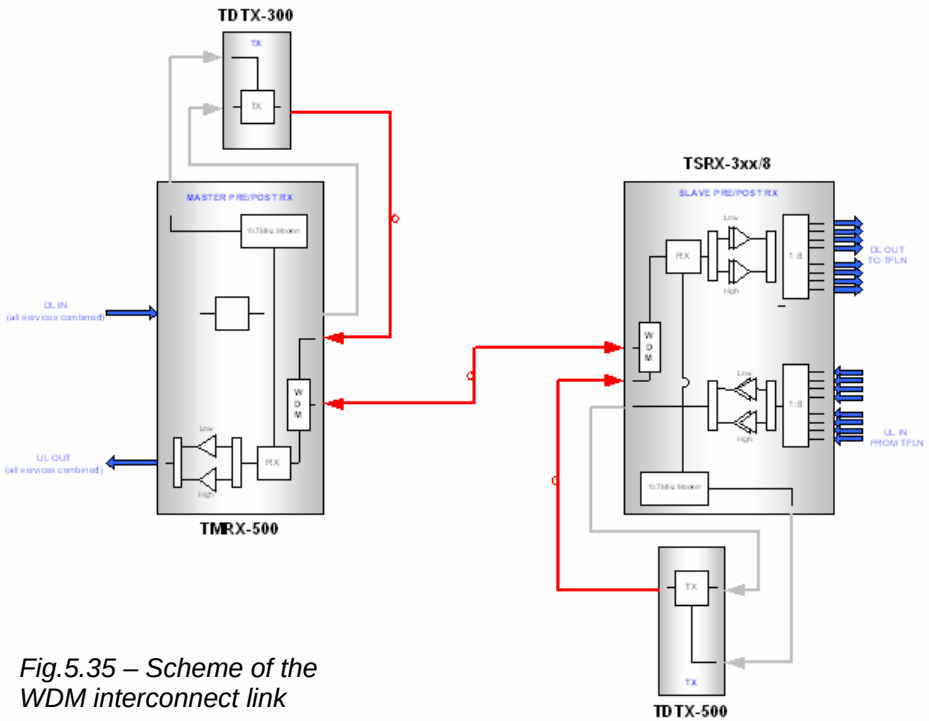


Fig.5.35 – Scheme of the WDM interconnect link

Main TILx-HLW functions:

Downlink:

Master side:

- RF-to-Optical conversion of the signal coming from the splitting/combining section, and transmission to the slave i-link modules via fiberoptics cable;
- Modulation and RF-to-Optical conversion of the bus information, and transmission to the slave i-link modules via fiberoptics cable (on 1310 nm wavelength);

Slave side

- Optical-to-RF conversion of signal and alarm information, with Automatic Gain Control (AGC) in order to compensate the optical losses;
- Distribution of the RF signal to the TFLN optical TRXs, and demodulation of the bus information

Uplink:

Master side:

- Optical-to-RF conversion of signal and alarm information, with Automatic Gain Control (AGC) in order to compensate optical losses
- Distribution of the RF signal to the splitting/combining section, and demodulation of the alarm information

Slave side:

- RF-to-Optical conversion of the signal coming from the TFLN optical TRXs, and transmission to the master i-link modules via fiberoptics cable;
- Modulation and RF-to-Optical conversion of the alarm information, and transmission to the master i-link modules via fiberoptics cable (on 1310 nm wavelength);

TILx-HLW Master Side: TDTX300 transmitter + TMRX500 receiver

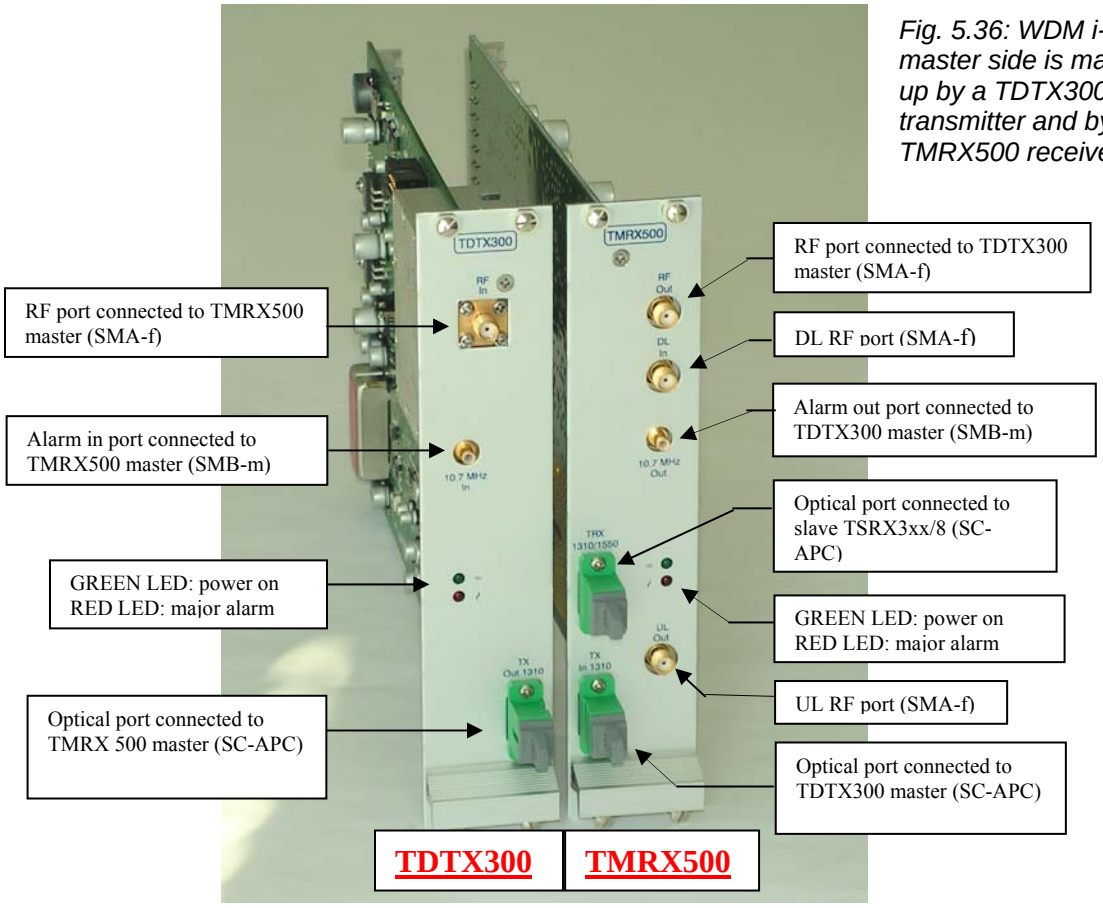


Fig. 5.36: WDM i-link master side is made up by a TDTX300 transmitter and by a TMRX500 receiver

TILx-HLW Master-side: *RF ports*

TDTX300 transmitter

- 1 RF input port , to be connected directly to the RF output port of the TMRX500 adjacent module
- 1 alarm input port, to be connected directly to the alarm output port of the TMRX500 adjacent module

TMRX500 receiver

- 1 RF output port, to be connected directly to the RF input port of the TDTX300 adjacent module
- 1 alarm output port, to be connected directly to the alarm input port of the TDTX300 adjacent module
- 1 RF DL port, sent to the passive devices which interface the Britecell with the BTS
- 1 RF UL port, coming from the passive devices which interface the Britecell with the BTS

TILx-HLW Master-side: *Optical ports*

TDTX300 transmitter:
- 1 output port (1310 out), to be connected directly to the optical input port of the master-side TMRX500 receiver

TMRX500 receiver:
- 1 input port (1310 in), to be connected directly to the optical output port of the master-side TDTX300 transmitter
- 1 WDM TRX port (1310/1550), to be connected to the TSRX3xx/8 module on the slave side

TILx-HLW Master-side: *LED Alarms*

TDTX300 transmitter: Two control LEDs (one green, one red) are placed on the TDTX300 front panel. The green LED describes the power supply status of the TDTX module, while the red LED describes the major TDTX failure.

TMRX500 receiver Two control LEDs (one green, one red) are placed on the TMRX500 front panel. The green LED describes the power supply status of the TDTX module, while the red LED describes the major TMRX failure.

Led colour	*Meaning*
Red	Optical power failure, wavelength out of range, power supply failure
Green	Power supply OK

Table 5.20. Summary of TDTX300 LEDs meaning

Led colour	*Meaning*
Red	Power supply failure, modem failure, RF UL failure, AGC compensation failure
Green	Power supply OK

Table 5.21 summary of TMRX500 LEDs meaning

TILx-HLW Slave-Side: TDTX500 transmitter + TSRX3xx/8 receiver

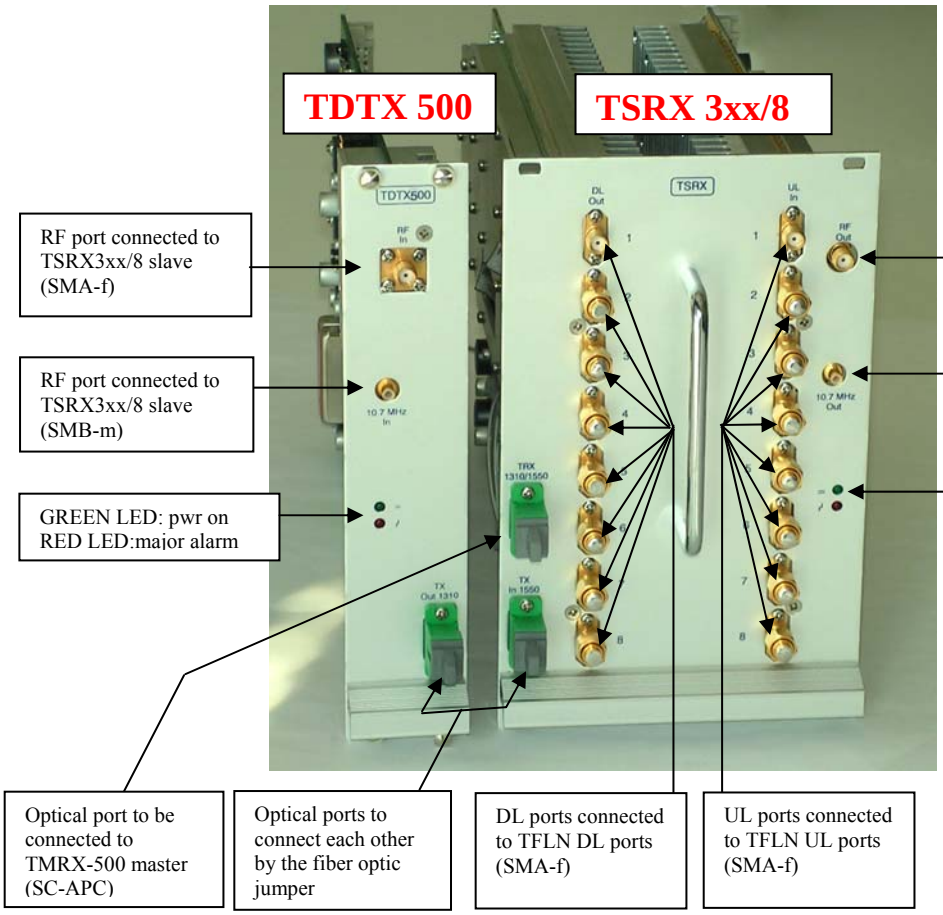


Fig.5.37: the WDM i-link master side is made up by a TDTX500 transmitter and by a TSRX3xx receiver

WDM I-link Slave-side: *RF ports*

TDTX500 transmitter:

- 1 RF input port , to be connected directly to the RF output port of the TSRX3xx/8 adjacent module
- 1 alarm input port, to be connected directly to the alarm output port of the TSRX3xx/8 adjacent

TSRX 3xx/8 receiver

- 1 RF output port, to be connected directly to the RF input port of the TDTX300 adjacent module
- 1 alarm output port, to be connected directly to the alarm input port of the TDTX300 adjacent module
- 8 RF DL ports, which can feed up to 8 TFLN local transmitters ;
- 8 RF UL ports, which can receive the UL signals from up to 8 TFLN local transmitters.

WDM I-link Slave-side: *Optical ports*

TDTX 500 transmitter:

- 1 output port (1550 out), to be connected directly to the optical input port of the slave-side TSRX 3xx/8 receiver

TSRX 3xx/8 receiver:

- 1 input port(1550 in), to be connected directly to the optical output port of the slave-side TDTX500 transmitter
- 1 WDM TRX port (1310/1550nm), to be connected to the TMRX500 module on the master side

WDM I-link Slave-side: *LED Alarms*

TDTX500 transmitter: Two control LEDs (one green, one red) are placed on the TDTX300 front panel. The green LED describes the power supply status of the TDTX module, while the red LED describes the major TDTX failure.

TSRX 3xx/8 receiver Two control LEDs (one green, one red) are placed on the TSRX3xx/8 front panel. The green LED describes the power supply status of the TDTX module, while the red LED describes the major TSRX failure.

Led colour	*Meaning*
Red	Optical power failure, wavelength out of range, power supply failure
Green	Power supply OK

Table 5.22: Summary of TDTX500 LEDs meaning

Led colour	*Meaning*
Red	Power supply failure, modem failure, RF UL and DL failure, AGC compensation failure
Green	Power supply OK

Table 5.23: Summary of TSRX3xx/8 LEDs meaning

Warnings (to be read before the TILx-HLW installation)

Dealing with optical output ports

- The TDTX modules (both on master and on slave side) contain 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

Inserting or removing TDTX, TMRX, TSRX modules

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

Positioning the TILx-HLW modules inside the subrack

- The i-link modules at slave side should be installed in the middle of the slave subrack, or at least they should have no more than 4 TFLN modules both on the right side and on the left side of the TSRX 3xx/8 module. This requirement is advised in order to allow connection between the TSRX module and all the TFLN transmitters (see fig. 5.39)

TILx-HLW installation

The TILx-HLW modules are provided with:

Master Cable Installation Kit:

- 1 SMA-Male/SMA-Male RF jumpers
- 1 SMB-Female/SMB-Female RF jumper
- 1 Fiber Optic Jumper

Slave Cable Installation Kit:

- 17 SMA-Male/SMA-Male RF jumpers
- 1 SMB-Female/SMB-Female RF jumper
- 1 Fiber Optic Jumper

Both on master side and on slave side, the WDM i-link modules are to be housed into a TPRN active sub-rack.

On the master-side station, the WDM i-link modules are to be housed into 2 adjiacent slots, chosen among the 12 available ones in the subrack.
On the slave-side subrack, the WDM i-link modules are to be housed into 4 adjiacent slots: moreover, due to the particular cabling they require, these 4 adjiacent slots should be placed in mid-subrack, so that no more than 4 TFLN local units stay on each side of the WDM i-link modules (see fig. 5.39).

Note: If the TILx-HLW modules are to be installed in an already working Master Unit, switch off the sub-racks before inserting the modules.

Before inserting the boards into the TPRNx4 subracks, make sure to set proper RS485 addresses. A basic rule of the Britecell installation is that 2 subracks belonging to the same Master Unit should always have different RS485 addresses (please refer to "TPRN Installation" section): since the interconnect-link basically provides an extension of the Master Unit bus, any subrack on the i-link master-side should also have a RS485 address different from any subrack on the i-link slave side.
Please refer to "TPRNx4 Installation" section for more information on setting the RS485 address.

Firstly, carefully insert the TMRX-500 and the TDTX-300 boards in 2 adjacent slots of the Master side subrack. Lock the 4 screws on the corners of each boards.
Use the provided SMA-m RF jumper in order to connect the RF Out Port of the TMRX500 module to the RF In Port of the adjacent TDTX300 module. Use the SMB-f jumper to connect the 10.7MHz ports of the two boards. Fix these RF jumpers to the RF ports through a proper torque wrench (not included).

Remove the protection cap from the optical ports of the 2 modules on the master side.
Take the optical jumper, clean the fibre connectors, and use it to connect the 1310 output port of the TDTX 300 and the 1310 input port of the TMRX500

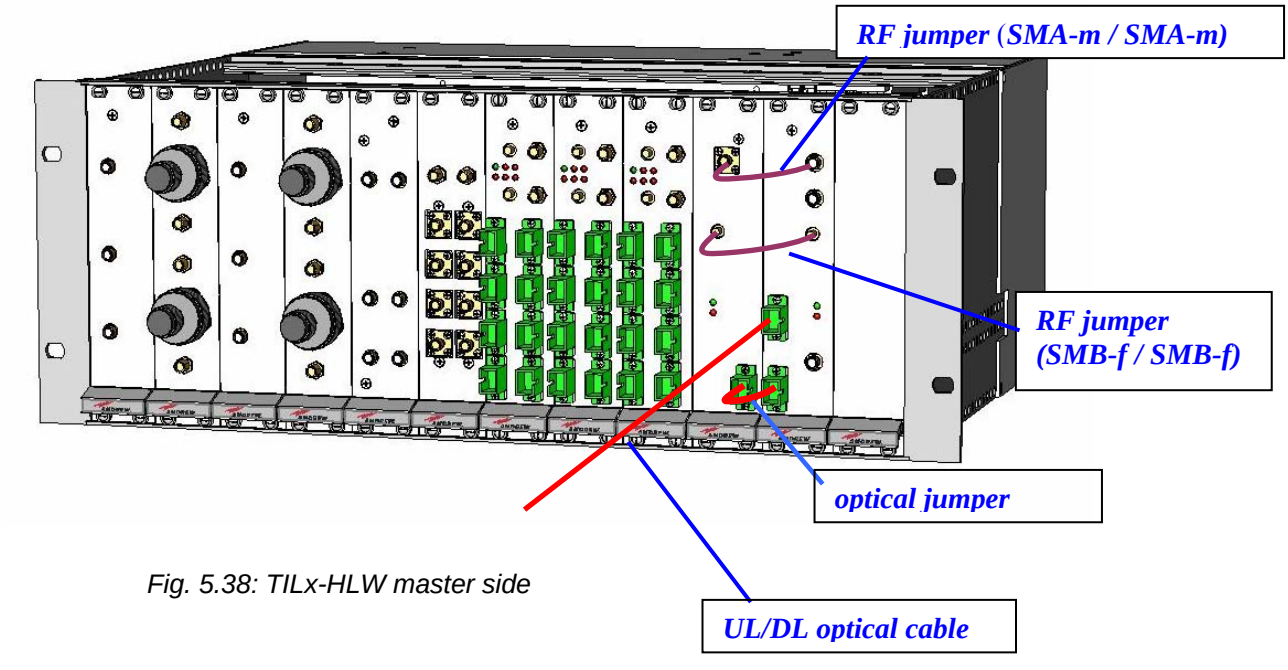


Fig. 5.38: TILx-HLW master side

module.

Take a SC-APC fiber, clean the fibre termination, and connect it to the 1310/1550 TRX port of the TMRX 500 module *(This fiber shall be directly connected to the 1310/1550 TRX port of the TSRX 3xx/8 on the slave-side subrack)*

Carefully insert the TSRX-3xx/8 and the TDTX-500 boards in 4 adjacent slots of the Master side subrack. As already explained, take care not to have more than 4 TFLN modules on each side of the i-link pieces. Lock the 4 screws on the corners of each boards.
Use the provided SMA-m RF jumper in order to connect the RF Out Port of the TSRX 3xx/8 module to the RF In Port of the adjacent TDTX500 module. Use the SMB-f jumper to connect the 10.7MHz ports of the two boards.
Use the longer RF jumpers (included) to connect each pair of TSRX UL and DL ports to the corresponding UL and DL ports of each TFLN module mounted on slave-side subrack. If less than 8 TFLNs are used at slave-side, make sure to mask the TSRX-3xx/8 unused DL and UL ports by SMA loads (not provided).

Remove the protection cap from the optical ports of the 2 modules on the slave side.
Take the optical jumper, clean the fibre connectors, and use it to connect the 1550 output port of the TDTX500 and the 1550 input port of the TSRX3xx/8 module.
Connect the 1310/1550 TRX port of the TSRX3xx/8 module to the fiberoptics cable coming from the 1310/1550 TRX port of the TMRX500 module on the master-side.

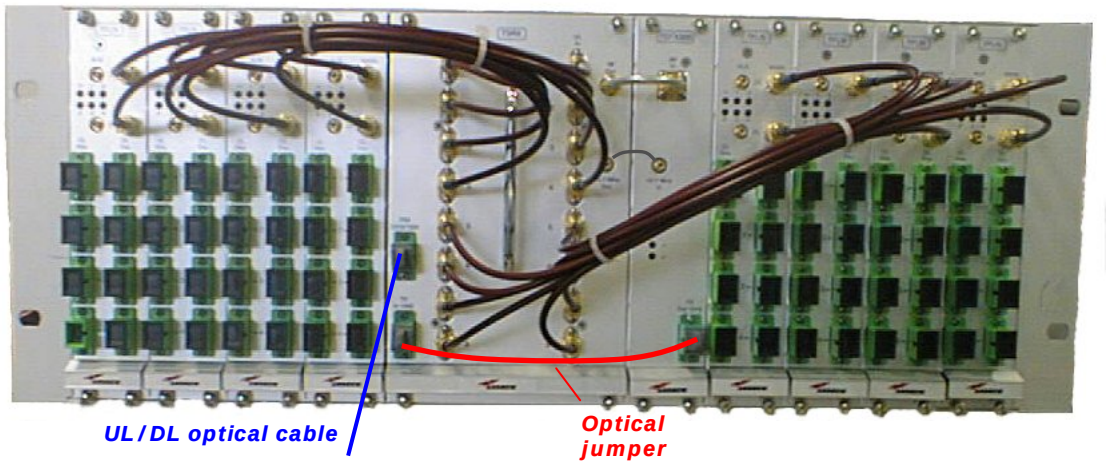


Fig. 5.39: TILx-HLW slave side

As you switch on the system, carefully refer to the "TILx-HLW start-up" section.

Removing a TILx-HLW module

To remove a TILx-HLW module, firstly switch off the TPRNx4 subrack which houses the module.

Remove the fibers and the RF jumpers connected to the WDM i-link module which is going to be removed. Insert the caps on the optical ports which has just been disconnected.

Unscrew the 4 screws at the corners of the WDM i-link module which is going to removed, and slowly remove the card.

Put the card in its safety box

TILx-WDM start-up

Before both the master side station and the slave-side stations are switched on, make sure that:

- all expected modules have been inserted into the Master Unit
- the modules have been connected each other by RF jumpers, according to what planned in the system design
- the TILx-HLW master modules have been connected to the relevant TILx-HLW slave modules through fiberoptics cables;
- every TFLN master optical TRX has been connected to relevant remote units
- each remote unit has been connected to its coverage antennas
- the remote supervision unit, if present, has been connected to the Master Unit
- both on the master-side and on slave-side stations, different subracks are connected each other via bus RS485

After that, remember that only when all the remote units are already on, the different subracks composing the Master Unit can be switched on. Once all the active subracks have been switched on, the behaviour of the different i-link modules can be summarized as follows:

- All the LEDs on the different TILx-HLW modules (both on master side and on slave side) turn on for a couple of seconds;
- After that, all the green LEDs on the different modules remain ON (thus indicating proper power supply), while the red LEDs switch off as soon as the master-side and the slave-side detect each other;
- During normal working operations, the status of the LED should be the one described in table 3.
- Once all the master-side and slave-side subracks have been switched on, the system should begin to work correctly. Anyway, in order that the i-link modules are recognized by the supervision management system, it is necessary that the system carries 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 LEDs ┌┘ blink. **Do not connect / disconnect any**

cable or any piece of equipment during the discovery phase! This may result in failing the identification of some equipment.

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).

- Finally, please note that the receiver module TSRX3xx/8 has only one connection with the subrack backplane, so that the LMT software and the supervision system will detect it as a 1-slot card. More in details, only the slot which hosts the TSRX LED alarms is recognized by LMT or supervision. The other 2 slots hosting the TSRX receiver are therefore to be masked through the LMT or the Supervision System Interface (please refer to the relevant user manuals) in order to avoid fictitious alarm notifications.

TILx-HLW troubleshooting

Faults on the i-link modules can be revealed:

- by LEDs on the front panels of the modules themselves
- by the LMT software running on a PC connected to a master side or a slave-side subrack via RS232 port;
- by the supervision system interface managed by the remote supervision unit, usually placed conveniently on the master-side.

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.
The tables 5.24, 5.25, 5.26, 5.27 report a brief description of alarm related to the different i-link modules, together with a reference to corresponding alerted LEDs and to possible recovery actions.

TDTX300 (master side)					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Vcc alarm	There is a degradation on the power supply provided by the backplane	RED	MAJOR	Return the unit	MAJOR
Optical Power < 1dB	The received optical power experiences a degradation which is near to the AGC working threshold (but it can still compensate losses)	NONE	MINOR	Check the optical loss / AGC status on the TSRX or TMRX module at the other side of the imterconnect link	MINOR
Optical power < 3 dB	The transmitted optical power experiences a degradation which can no more be compensated by the AGC.	RED	MAJOR	Return the unit	MAJOR
Temperature Alarm	Over-temperature alarm	NONE	WARNING	Check the subrack and cabinet ventilation, verify the environmental conditions involving heating and air circulation	MINOR

Table 5.24: Description of the TDTX300 alarms, as they are described by the LMT software or by the supervisione interface

TMRX500 (master side)					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Power supply alarm	There is a degradation in power supply distribution	RED	MAJOR	Return the unit	MAJOR
AGC out of range	The received optical power experiences a degradation which is near to the AGC working threshold (but it can still compensate losses)	NONE	WARNING	Check the optical loss / AGC status on the TSRX or TMRX module at the other side of the imterconnect link	MINOR
Optical power fail	The transmitted optical power experiences a degradation which can no more be compensated by the AGC	RED	MAJOR	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	WARNING	Check the subrack and cabinet ventilation, verify the environmental conditions involving heating and air circulation	MINOR
FSK modem alarm	HW problem on the 10.7 MHz FSK modulator/ demodulator	RED	CRITICAL	Return the unit	MAJOR
UL RF alarm	UL Hardware failure	RED	MAJOR	Return the unit	MAJOR
Current Fail	Overcurrent alarm	RED	MAJOR	Return the unit	MAJOR

Table 5.25: Description of the TMRX500 alarms, as they are described by the LMT software or by the supervisione interface

TDTX500 (slave side)					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Vcc alarm	There is a degradation on the power supply provided by the backplane	RED	MAJOR	Return the unit	MAJOR
Optical power < 1 dB	The received optical power experiences a degradation which is near to the AGC working threshold (but it can still compensate losses)	NONE	MINOR	Check the optical loss / AGC status on the TSRX or TMRX module at the other side of the imterconnect link	MINOR
Optical power < 3 dB	The transmitted optical power experiences a degradation which can no more be compensated by the AGC.	RED	MAJOR	Return the unit	MAJOR
Temperature Alarm	Over-temperature alarm	NONE	WARNING	Check the subrack and cabinet ventilation, verify the environmental conditions involving heating and air circulation	MINOR

Table 5.26: Description of the TDTX500 alarms, as they are described by the LMT software or by the supervisione interface

TSRX3xx/8 (slave side)					
ALARM CODE (TSUN description)	***ALARM DESCRIPTION***	***ACTIVE LED***	***SUPERVISION PRIORITY LEVEL***	***ACTION RECOMMENDED***	***RELÉ PRIORITY LEVEL (subrack)***
Power supply alarm	There is a degradation in power supply distribution	RED	MAJOR	Return the unit	MAJOR
AGC out of range	The received optical power experiences a degradation which is near to the AGC working threshold (but it can still compensate losses)	NONE	WARNING	Check the optical loss / AGC status on the TSRX or TMRX module at the other side of the interconnect link	MINOR
Optical power fail	The transmitted optical power experiences a degradation which can no more be compensated by the AGC	RED	MAJOR	Return the unit	MAJOR
Temperature alarm	Over-temperature alarm	NONE	WARNING	Check the subrack and cabinet ventilation, verify the environmental conditions involving heating and air circulation	MINOR
FSK modem alarm	HW problem on the 10.7 MHz FSK modulator/demodulator	RED	CRITICAL	Return the unit	MAJOR
DL Low band RF alarm	HW failure on the DL RF low band	RED	MAJOR	Return the unit	MAJOR
DL High band RF alarm	HW failure on the DL RF high band	RED	MAJOR	Return the unit	MAJOR
DL UMTS RF alarm *(only on TSRX 347/8 version)*	HW failure on the DL RF UMTS band	RED	MAJOR	Return the unit	MAJOR
UL Low band RF alarm	HW failure on the UL RF low band	RED	MAJOR	Return the unit	MAJOR
UL High band RF alarm	HW failure on the UL RF high band	RED	MAJOR	Return the unit	MAJOR
UL UMTS RF alarm *(only on TSRX 347/8 version)*	HW failure on the UL RF UMTS band	RED	MAJOR	Return the unit	MAJOR
Current Fail	Overcurrent alarm	RED	MAJOR	Return the unit	MAJOR

Table 5.27: Description of the TSRX3xx/8 alarms, as they are described by the LMT software or by the supervisione interface

As shown by these tables, the LEDs show only the alarms concerning the board where they are housed: so, a red LED which is switched on at TSRX front side reveals an alarm affecting the TSRX module itself (it does not deals with the alarms affecting the other module of the i-link slave-side, which is an TDTX300, and whose alarms will be detected by its own LEDs). Moreover, these tables show that the LEDs reveals only major alarms, 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 possibile system faults.
Although any alarm detected by a LED on the i-link modules should be verified through LMT or supervision software when an accurate check is needed, some ordinary maintenance procedures could be carried out quickly following the instructions described hereinafter.

TDTX300 and TDTX500 troubleshooting

The TDTX modules are basically two optical transmitters whose alarm status cannot be influenced by dirt optical adapters or by some problems in fiberoptics cables. If any red light is switched on in a TDTX front panel, please check if you have connected properly the RF jumpers. If the RF connections prove to be ok and the red LED keeps on switching on, please contact the manufacturer.

TMRX500 module troubleshooting

Ordinary troubleshooting procedures which can be carried out on TMRX500 module first involve a check of the optical adapters status and of the fiberoptics cables. If the alarm status still persists, a reboot of both the TMRX500 module and of the TSRX3xx/8 module can be performed so as to re-inizialize the link.

Quick TMRX-500 troubleshooting procedure

(The following procedure is summarized by the flow-chart in fig. 5.40b)
In case the red LED is ON, please follow these steps:
1. Clean the optical adapter
2. If the problem still persists, refer to TMRX/TSRX fiber optical troubleshooting so as to check if the optical connectors and, the optical cable and the optical jumpers have some problems.
3. If previous actions didn’t make the LED switch off, a reboot of both the TMRX500 module and of the TSRX3xx/8 module (on the slave-side) could be performed so as to test modem connectivity.
4. If the red LED still remains on, please check the alarm status by the LMT or the supervision unit in order to better understand the problem and its possible solution.

TMRX/TSRX fibre optic troubleshooting

(The following procedure is summarized by the flow-chart in fig. 5.40b)

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 TMRX (TSRX) 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 more firmly the SC-SPC connectors to their adapters. If the TMRX (TSRX) 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 also the relevant SC-APC adapters. Re-connect the fibre to relevant ports after cleaning. If it doesn't make TMRX (TSRX) red LED switch off, follow next steps.
4. Disconnect the fiber from the TMRX (TSRX) port, and measure the power Pout which comes out from the fiber. Then, go to the module where the other end of the fiber is connected (it can be either on the slave side and on the master side, depending on the fiber or on the jumper you are verifying), disconnect it and measure the input power Pin coming out of the port. Calculate the fibre attenuation A due to the fiberoptics cable: Af [dB] = Pin – Pout
   a. If Af > 10 dB, then the fibre optic cable has some problems. Replace it with a new one.
   b. If Af < 10 dB troubleshooting procedure has not identified the problem. Refer to supervision system or contact the manufacturer for assistance.

TSRX3xx/8 module troubleshooting

Ordinary troubleshooting procedures which can be carried out on TMRX200 module first involve a check of the optical adapters status and of the fiberoptics cables. If the alarm status still persists, a reboot of both the TMRX-500 module and of the TSRX3xx/8 module can be performed so as to re-inizialize the link.

Quick TSRX3xx/8 troubleshooting procedure

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

1. Clean the optical adapter
2. If the problem still persists, refer to the fibre optic troubleshooting so as to check if the optical cable or optical connection has any problem.
3. If previous actions didn't make the LED switch off, a reboot of both the TSRX3xx/8 module and of the TMRX500 module (on the master side) could be performed so as to test modem connectivity.
4. If the red LED still remains on, please check the alarm status by the LMT or the supervision unit in order to better understand the problem and its possible solution.

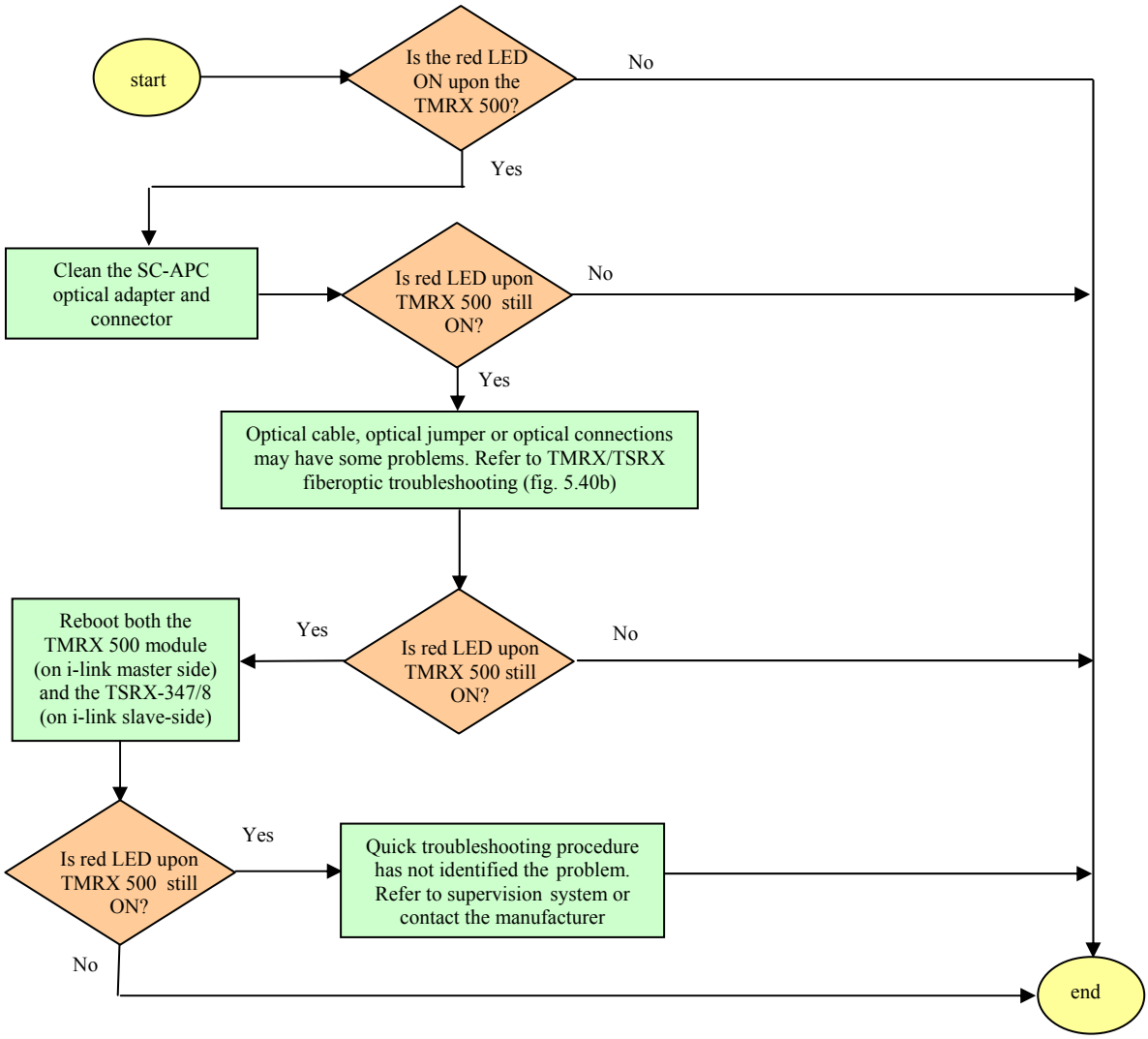


Fig. 5.40a: Flow-chart describing the quick TMRX500 troubleshooting.

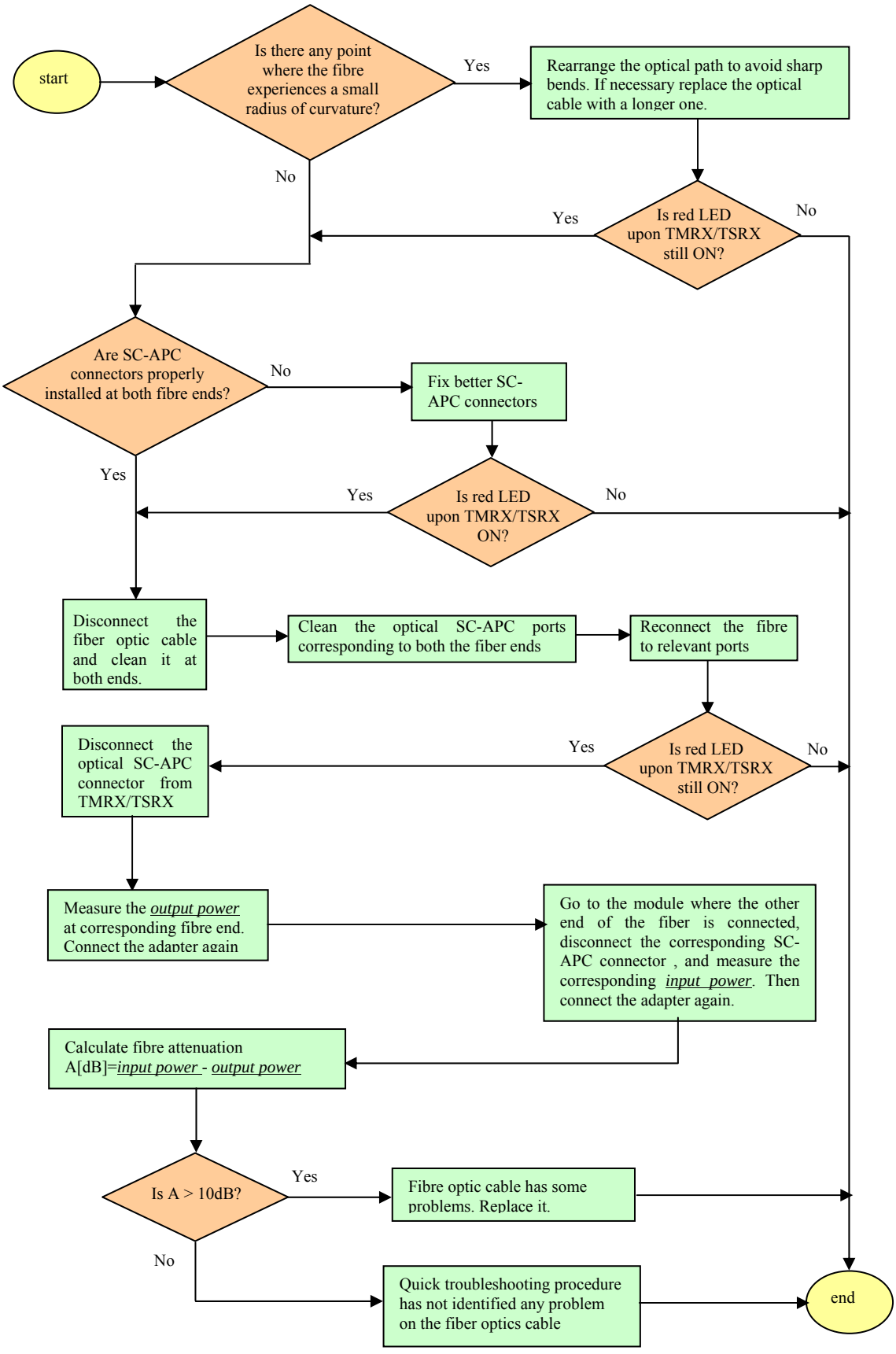


Fig. 5.40b: Flow-chart describing the TMRX/TSRX fiberoptic troubleshooting.

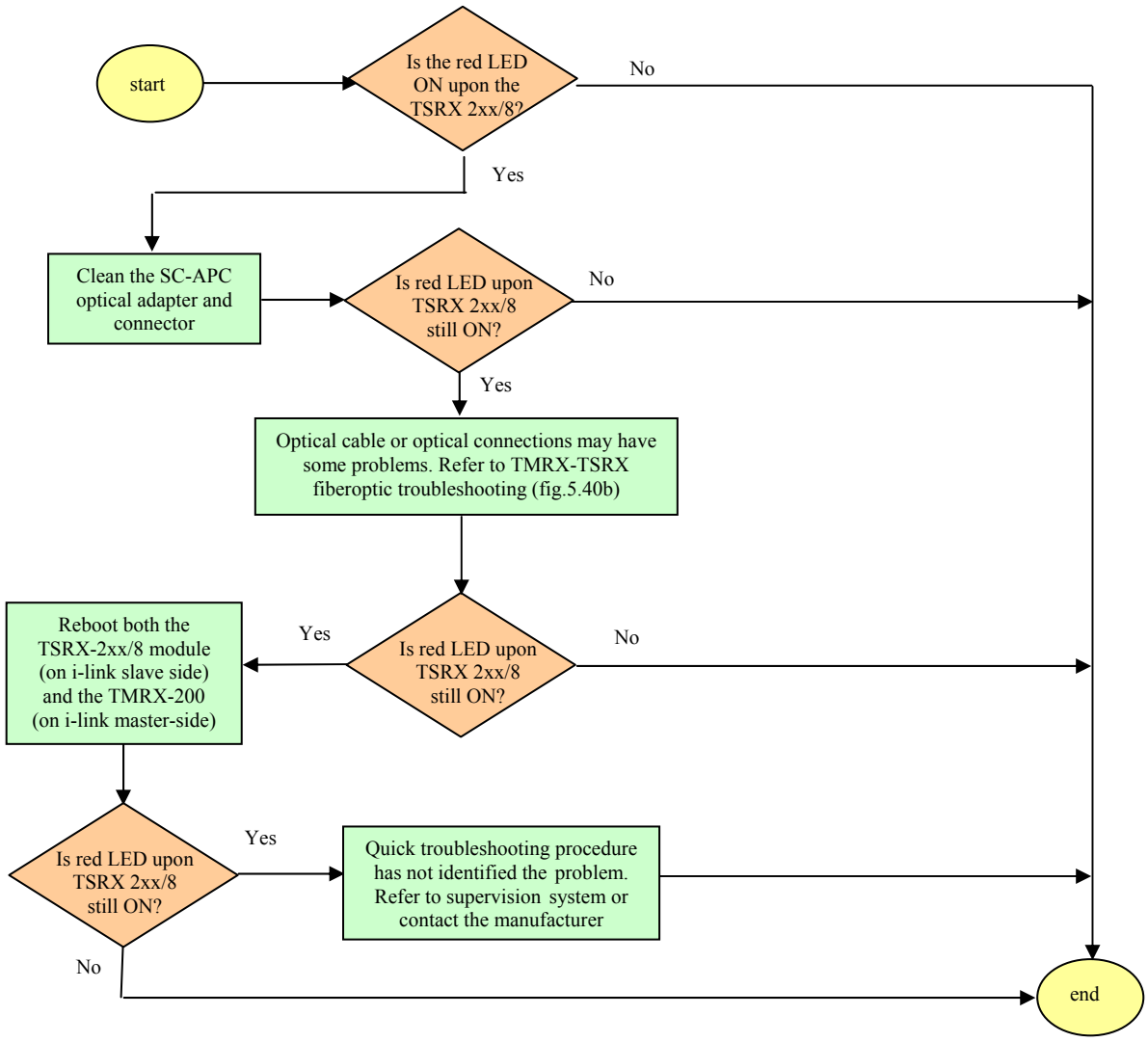


Fig. 5.40c: Flow-chart describing the quick TSRX3xx/8 troubleshooting.

5.11. Remote Supply TRS/TRSN

The TRS/TRSN is a sub-rack unit which provides remote supply to up to 24 remote units, by means of dedicated outputs with short-circuit protection switches.
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 supply 0.5A per port: it can feed only single and dual band TFAN remote units, as well as the TFAM20 one.

The TRS/TRSN unit provides DC power supply to the remote units through standard AWG14/16 copper lines. Maximum allowed distances depend on the section of these copper lines, on the remote unit current consumption, and on the voltage range.

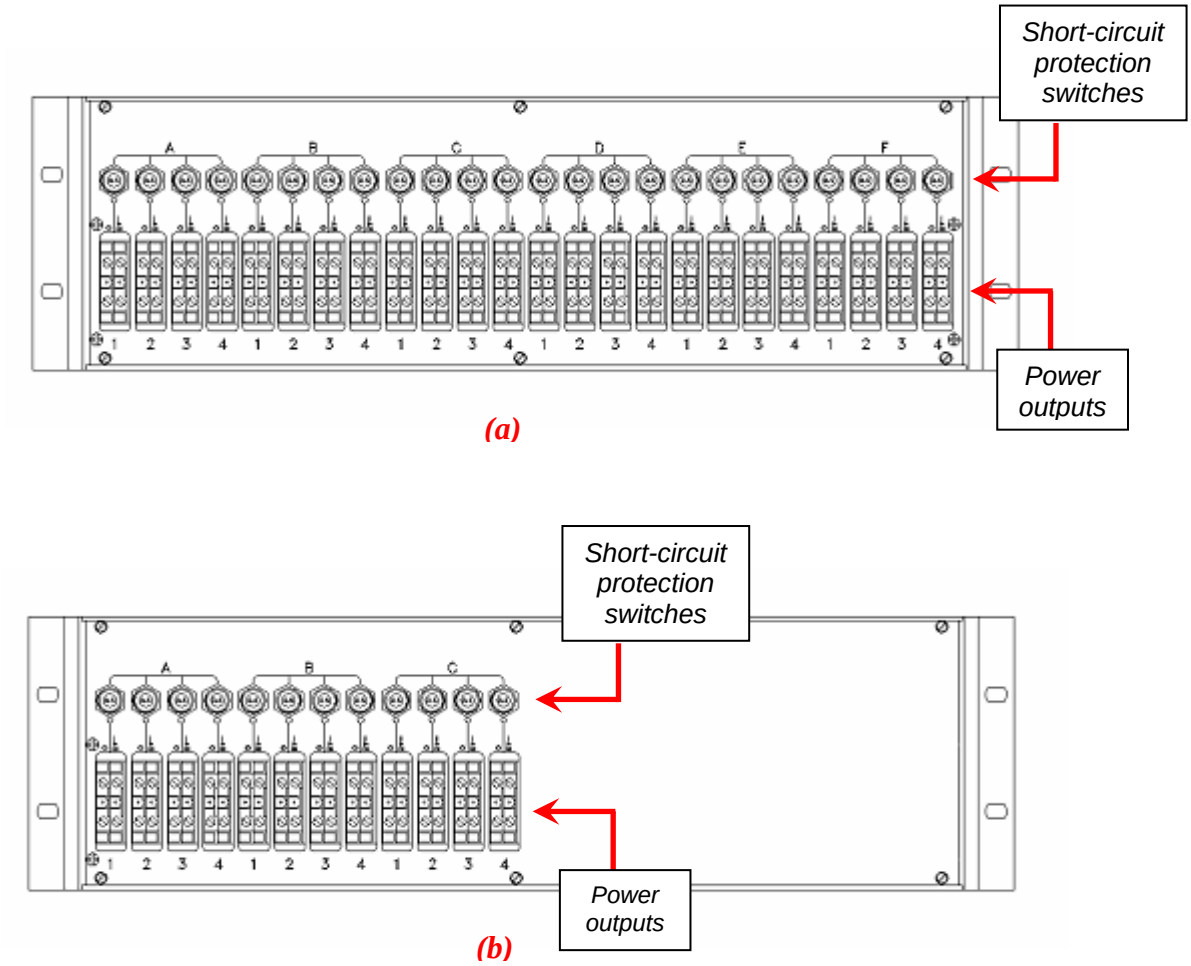


Fig. 5.41. (a) Front panel of a TRSN or a TRS sub-rack provided with 24 power supply outputs. (b) Front panel of a TRSN sub-rack provided with 12 power supply outputs.

Fig. 5.42. Picture of 12- output TRSN subrack.

Ports

The TRSN version (suitable to all types of remote units) is available with

- 12 supply outputs
- 24 supply outputs

It can supply 1 A per port.

The TRS version (suitable to single and dual band TFAN remote units and to TFAM20) is available with 24 supply outputs. It can supply 0.5 A per port.

Power supply

Both the TRS and the TRSN subracks can be feeded either by 115 Vac mains or by 230 Vac mains (50/60Hz). The proper feeding voltage has to be selected through a voltage selector which is placed on the back panel, near the mains connector .
Thanks to the active distribution system (please refer to the electrical scheme in fig. 5.45a), a -48 Vdc power supply be conveyed to the remote units connected to the output ports.

(a)

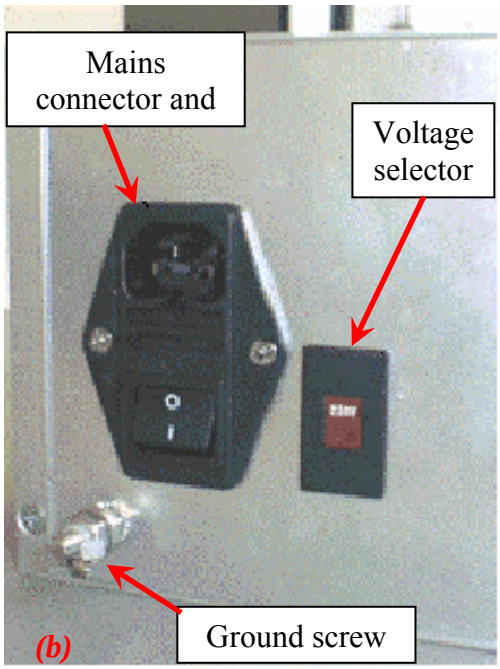
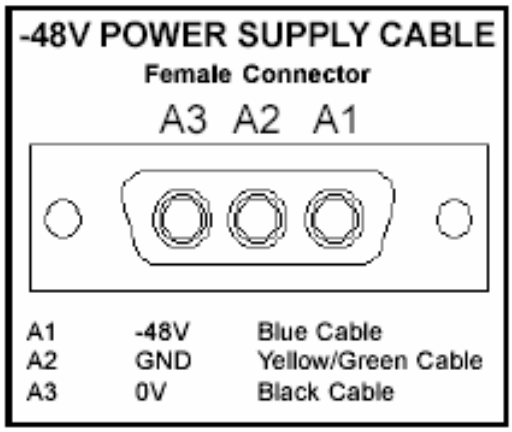


Fig. 5.43. Picture of the rear side of the TRS/TRSN subrack feeded by 115Vac-230Vac mains (a). Mains connector, fuse, voltage selector and ground screw on the TRS/TRSN rear panel(b).

The TRSN subrack is also available in passive version TRSNx-3, which can be feeded by direct current (–72 to –36 Vdc). In this case, the -48 Vdc current is conveyed to the remote units thanks to a passive distribution system (please refer to fig. 5.45b).
Please read carefully the cabling instructions in order to connect the provided power cable to the poles of the -48 Vdc connector properly (see fig.5.44b).

(a)



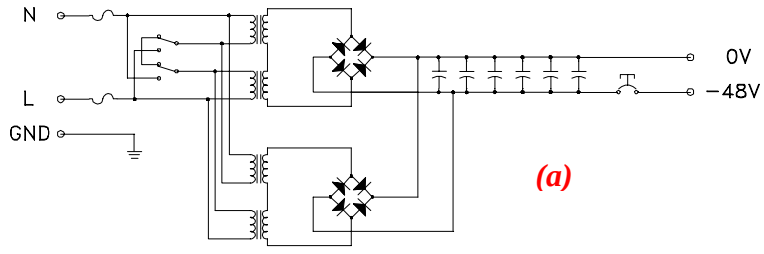
(b)

Fig. 5.44. (a): Power supply connector, fuse, voltage selector and ground screw on the the rear side of the TRSN subrack feeded by -48 Vdc current TRS/TRSN rear panel. (b) Cabling instructions for the -48 Vdc connector

Ground terminals are part of the power supply connectors. External grounding terminals (screw) are also available (see fig. 5.43a,b)

Mains connectors also house the following fuses:

- 250V, 4A delayed type for the active version (feeded by 115 Vac mains or by 230 Vac mains)
- -48V, 15A delayed type for the passive version (feeded by -48 Vdc supply)



(a)

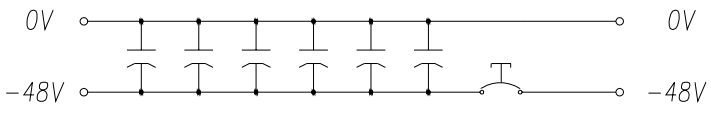


Fig. 5.45.
(a) Active distribution system used by a TRS/TRSN subrack feeded by 115Vac-230Vac mains
(b) Passive distribution system used by a TRSN subrack feeded by a -48 Vdc power supply,

Warnings

- Caution: do not open the unit before disconnecting the mains. Internal assemblies can be accessed by qualified personnel only.
- Do not connect supply outputs to remote units before switching off the unit or disconnecting the mains.

Being a DC supply provided, a wrong connection can damage the remote unit. Verify the proper polarity before switching on the equipment

TRS / TRSN installation

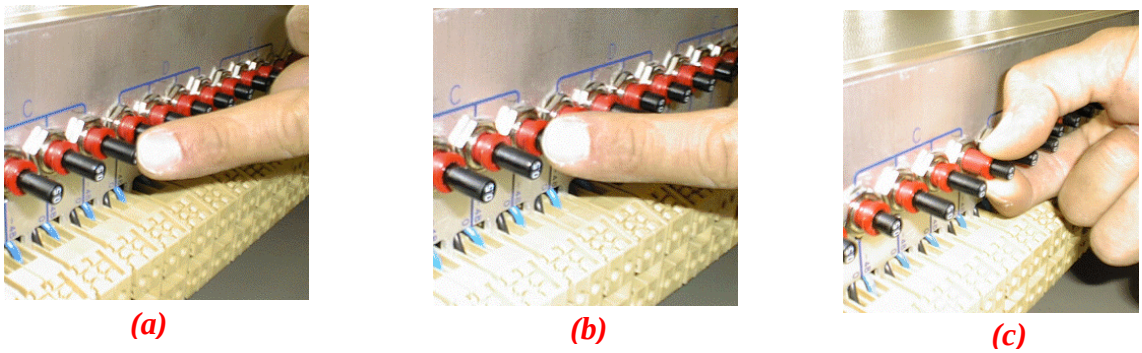
The TRS/TRSN sub-rack should be placed as close as possible to the TPRN to allow an easy cabling in case of mixed fibre-copper cables. If the sub-rack mounting location is not provided with a good air circulation, leave at least one unit free between sub-racks.
The kit includes

- 1 TRS/TRSN
- 1 power cable

To install the TRS/TRSN remote supply unit follow next steps:

1. Fix the TRS/TRSN sub-rack to the cabinet with 4 screws
2. During the installation phase don't connect the power cable to the main power line and don't switch on the TRS/TRSN
3. Set the switch in accordance with your main power line (115 Vac or 230 Vac) for universal mains option. In case of negative supply option (-48 Vdc), no switch is provided. Then connect the ground screw.
4. Before connecting the wires from TRS/TRSN to the remote units, open all the fuses pulling the red circle then connect electrical wires for the remote units (5.46c)
5. When all electrical wires have been connected and the system is ready to start, connect the power cable, switch on the TRS/TRSN. Push one fuse at a time (5.46b).

Each remote unit can be switched on/off by the relevant switch. The Pictures 5.46 below show how to do it.



(a) *(b)* *(c)*

Fig. 5.46 Short circuit protection switches. (a): OFF position . (b): ON position: push down the black button. (c): Pull out the red collar in order to switch off.

If a surge or an overloading condition occur the switch automatically jump into an OFF position.

TRS / TRSN behaviour at start-up

- Check if power supply voltage selector is in the correct position (115 or 230 Vac). In passive distribution version this selector is not present.
- Have all the switches in off position
- Check the connection polarity is not wrong
- Power on the TRS/TRSN unit through the back general switch
- Power on each remote unit through the front panel switches
- Check if the remote units shows the proper green supply led on

TRS / TRSN troubleshooting

If the remote unit doesn't appear to be properly supplied:

- Check the fuses on the rear panel
- Check the voltage at the front panel screw connectors: nominal value without load is -59Vdc, nominal value with full load is -48Vdc. If those values are exceeded by 10% check if the mains are within the allowed limits. In passive distribution version, the output voltage depends on the supply source.
- Check the voltage at the remote side it should be in the range -36 to -72 Vdc that is the maximum allowed range admitted by the remote units.

If the protection switch jump always in OFF position

- Check if there is any short on the line
- Check if the remote unit shows the nominal current power consumption
- Check if there was any long period overshooting related to the mains supply.

If the fuses blow up after a power-on with all the front switches on, there should be a too high initial peak current transient: check the proper fuse (delayed type) or substitute with an higher current fuse (i.e. 6A or 10A). If the problem still persists check the proper ground /mains connection.

6. Warning and Safety Requirements

6.1. Environmental Conditions

This equipment is designed to be installed in indoor environments.

Operating temperature:	+5 to +40°C	(for all the pieces of equipment, except remote units case L)
	-20 to +50°C	(only for remote units case L)

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

6.2. Installation Site Features

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

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

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

- do not install remote units inside heating or conditioning;
- do not install remote units inside cable pipeline or fire-prevention site (fire escape, lift tunnels, emergency exits, which have to guarantee defined safety standards);
- keep into consideration that the temperature in the upper part of a room is higher than at 2 meter height. For false ceiling installation of case-A and case-B remote units, verify that the environment temperatures do not exceed allowed limits;

- each remote unit requires its own power and a connection to the mains can be needed;
- keep into consideration that each remote unit transmits RF signal and safety volume must be respected (refer to country regulations for safety volume magnitude);
- remote units must be mounted according to what specified in the relevant installations instructions;
- Weight and dimensions of case-L and case-F remote units should be carefully considered when choosing the installation site and positioning. During any installation step, please consider the potential risk of any equipment drop off
- When choosing the installation site and position, please consider that any remote units must be accessible for tests and maintenance.

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

6.3. Safety and Precautions during Installation or maintenance

During installation the following means and tools will be needed:

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

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

CAUTION: Do not paint or otherwise coat Britecell Plus equipment.

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

CAUTION: Case-F and Case-L remote units are provided with some door panels which have to be managed with care during installation or maintenance operations.. Always switch off the remote while working with the panel opened. When closing the panels, take care not to leave any tool inside the equipment, not to hurt your fingers, and not to trap clothes, bracelets, chains, or long hair.

Never remove the cover from a TFAx remote unit or from a TPRN subrack when the power supply is ON.

6.4. Power Supply Connection

Power connection has to be carried out following all necessary precautions:

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

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

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

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

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

6.5. Safety and Precautions for Lasers

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

- Never look directly inside the optic connector exit of the transmitters when it is switched on. The wavelength of the laser is not visible to the human eye, which means that long-term damage will not be immediately known.

- When working with the optical connectors, check at each end that both transmitting lasers are switched off.

6.6. 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).

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

- The manufacturer rated output power of the equipment is for single carrier operation. For situations in which multiple carrier signals are present, the rating would have to be reduced by 3.5dB especially when 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.
- To satisfy RF exposure requirements, the antenna(s) used for the system must be installed to provide a separation distance of at least 20cm from all people and the highest antenna gain which can be used is 12dBi.

6.7. Electromagnetic Fields and RF Power

Britecell Plus system generates electromagnetic radiation, which can exceed safety levels in the immediate vicinity of the antenna.

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

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

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

This equation includes the following factors:

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

(*please note that, if regulations only define the maximum electrical field strength and the maximum magnetic field strength, the allowed power density can be obtained as:* $S = E^2/377 = B^2 \cdot 377$, *where 377 is the characteristics impedance of the empty space).*

Example 1. Let's suppose to use a High Power TFAH20 to distribute CDMA signals through a directional antenna, feeded by a 2-metre length RG223 cable (no splitters used). Let's suppose the antenna gain is 7 dB.

Let's assume, moreover, that the maximum allowed power density we have to comply with is: $S = 10\ W\ m^{-2}$
(typical ICNIRP reference level for general public exposure to time-varying electric and magnetic fields).

By reading the Britecell bulletin, we know that the output power P at the TFAH20 antenna port is 37 dBm (=5.012 W). By reading the cable specs, we get that RG223 cable losses can be estimated as 0.55 dB/m. Total losses between the TFAH20 output port and the antenna input port can therefore be estimated as follows:

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

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

$$r_{min} = \{ 10 \cdot \exp [(7 - 1.1) / 10] \cdot 5.012\} / (4 \cdot \pi \cdot 10) \} \cdot \exp (-1/2) = 0.394\ m$$

Example 2. Let's suppose to use a Low Power TFAM85/19 through a directional antenna, feeded by a 5 -metre length RG223 cable with a 2-way splitter. Let's suppose that the antenna Gain is 7 dB and that our Britecell system distributes one Cellular800 carrier and one PCS 1900.
Let's assume that the maximum allowed power density we have to comply with is: $S = 50\ W \cdot m^2$
(typical ICNIRP reference level for occupational exposure to time-varying electric and magnetic fields)

By reading the Britecell bulletin, we know that the output power per carrier at the TFAM antenna port is 21 dBm (=0.126 W) for the Cellular 850 MHz frequency band, and 20 dBm (0.1 W) in the PCS 1900 MHz frequency band. The total output power at the antenna port is therefore P = 0.126 + 0.1 = 0.226 W.
Let's assume that the splitter insertion losses are 3.5 dB. By reading the cable specs, we get that RG223 cable losses can be estimated as 0.55 dB/m. Total losses between the TFAM85/19 output port and antenna input port can therefore be estimated as follows:

$$L = 0.55\ (dB/m) \times 5\ (m) + 3.5 = 5.25\ dB$$

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

r_{min} = { 10 · exp [(7 - 5.25) / 10] · 0.226} / (4·π·50) } · exp (-1/2) = 0.023 m

Example 3. Let's suppose to have a Low Power TFAM90/20 connected to an omnidirectional antenna through a 20-metre length ½" cable (no splitters used). Let's suppose that the antenna Gain is 7 dB and that our Britecell system distributes two GSM900 carriers and one UMTS2100 carrier. Moreover, let's assume that the maximum allowed electrical field strength is:

$$E = 6 \text{ V m}$$

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

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

By reading the Britecell bulletin, we get that the output power at the TFAM antenna port is 14 dBm/carrier (=0.025 W) for a 2-carrier GSM900 MHz distribution, and 17 dBm (0.05 W) for 1 WCDMA carrier.
The 900 MHz and 2100 MHz output powers at the remote unit ports are:

$P_{900MHz,TFAx}$ = 0.025W+0.025W=0.05W (for 900MHz signals)
$P_{2100MHz,TFAx}$= 0.05W (for 2100MHz signals)

Let's assume that the ½" cable losses are 0.07 dB/m in the 900 MHz band and 0.18 dB/m in the 2100 MHz band; the total losses between the TFAM90/20 output port and the antenna input ports can therefore be estimated as follows:

L_{900MHz} = 0.07 (dB/m) x 10 (m) = 0.7 dB on 900MHz signals
$L_{2100MHz}$=0.18 (dB/m) x 10 (m) =1.8 dB on 2100MHz signals

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

$P_{900MHz, ant}$ = 10 exp[(7-0.7)/10]· 0.05 = 0.213 W
$P_{2100MHz,ant}$ = 10 exp[(7-1.8)/10]·0.05 = 0.165 W
$P_{composite}$= $P_{900MHz, ant}$ + $P_{2100MHz,ant}$= 0.378W

By dividing the total power through (4·π·S) and taking the square root according to the relation 6.1, we therefore get the the following minimum safety distances from the antenna:

r_{min} = { $P_{composite}$ /(4·π·0.1)} · exp (-1/2) = 0.54 m

6.8. Warning Labels

Fig. 6.1:
Laser safety Label

CLASS 1 laser product

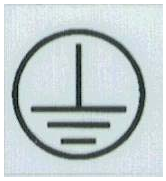


Fig. 6.2:
Ground Label

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

Fig. 6.3:
WEEE Identification Label

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

Please refer to Appendix B for further details about the equipment disposal

7. TECHNICAL SUPPORT

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

North America (toll free) to U.S.A.

Telephone 1-800-255-1479

Fax 1-800-349-5444

Any Location (International) to U.S.A.

Telephone + 1(708) 349-3300

Fax + 1 (708) 349-5410

Britecell Plus is developed by:

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

Useful information about the product are available on the dedicated pages of Andrew's website:

http://www.andrew.com/products/inbuilding/

For further information about the product, please write to:

Britecell@Andrew.com

In order to address us any question, comment or suggestion, you can also go to following page of the Andrew's website:

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

7.1. Returning equipment

Before returning some equipment to the manufacturer for repairing or replacing, the customer should give prior notice to the manufacturer and ask the Return Material Authorisation (RMA request).

Before sending any piece of equipment to the manufacturer, you must send us the following RMA request form via fax (+39 0546 682768) or via e-mail (britecell@andrew.com).

RMA REQUEST FORM

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

[1]Please refer to the serial label

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

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

The returned pieces can be repaired (when possible) or replaced (when no repairing can be carried out). These operations can be performed under warranty (please see the warranty conditions specified in the sales contract) or out-of-warranty. In the latter case, we will send you a quotation for equipment repairing or replacement.
When returning the repaired or replaced equipment, the manufacturer will issue a check report, which will included in the packaging together with the returned pieces. The customer will be informed about any corrective actions suggested by quality assurance.

Appendix A: System Commissioning

The following flow charts want to be a quick reference for Britecell Plus® system installation and commissioning.
The first flow chart (see Fig. A.1) highlights the main steps for system installation and commissioning starting from the equipment unpacking up to the check of the coverage and call quality.

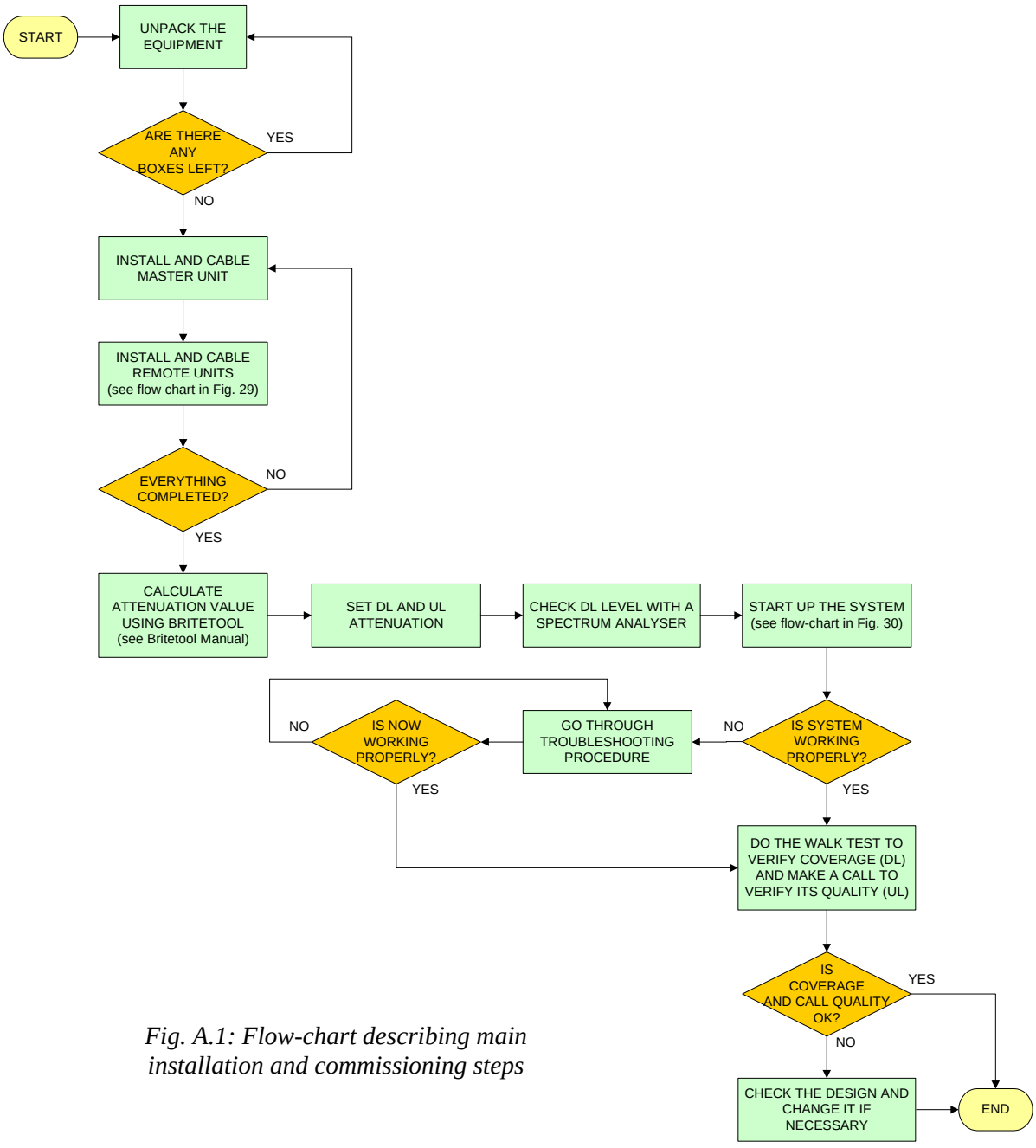


Fig. A.1: Flow-chart describing main installation and commissioning steps

The previous flow chart contains the following cross references:

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

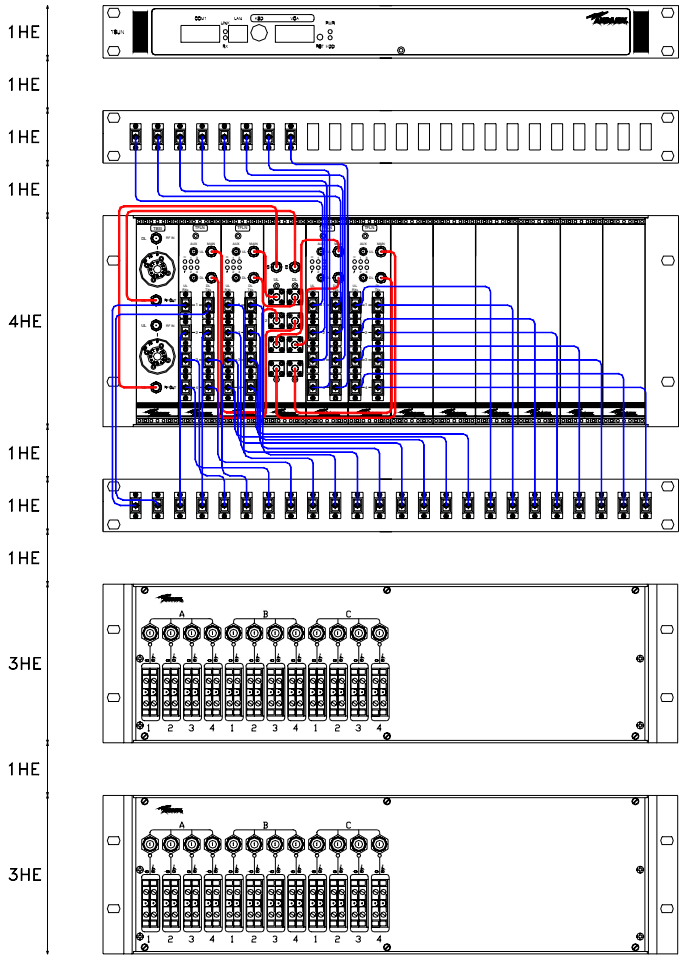


Fig. A.2: Cabinet layout for a 1 sector with 4 TFLN master optical TRXs configuration

- once the whole system has been installed, the attenuation on the base station interface has to be defined in order to set up the performances. Use the Britetool Software to calculate the required attenuation values for uplink and downlink. Refer to Britetool manual for more information on how to use it.
- the system start-up is described in more details in the flow chart in figure A.4. It takes care of the flow of actions from the remote and

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

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

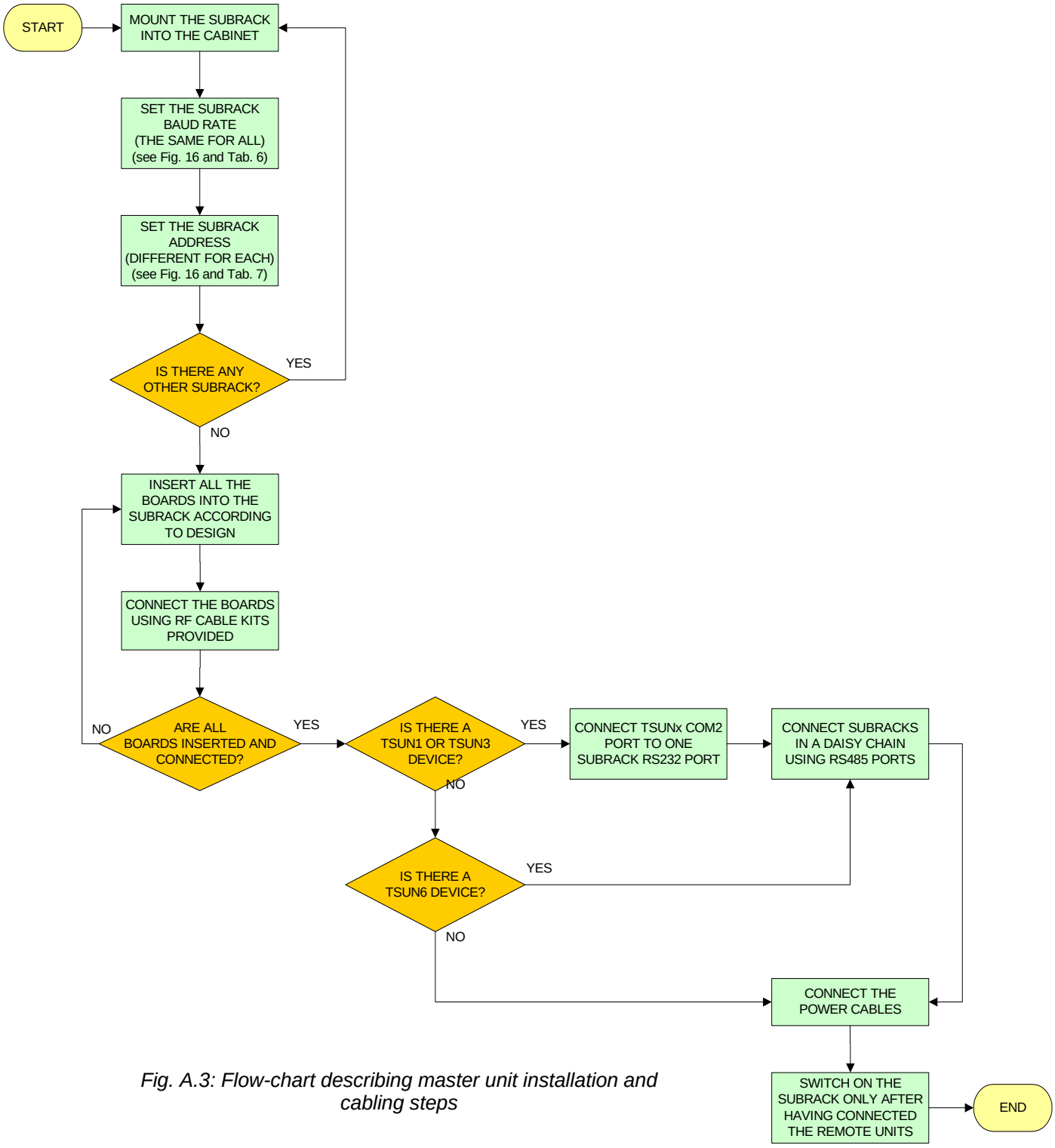


Fig. A.3: Flow-chart describing master unit installation and cabling steps

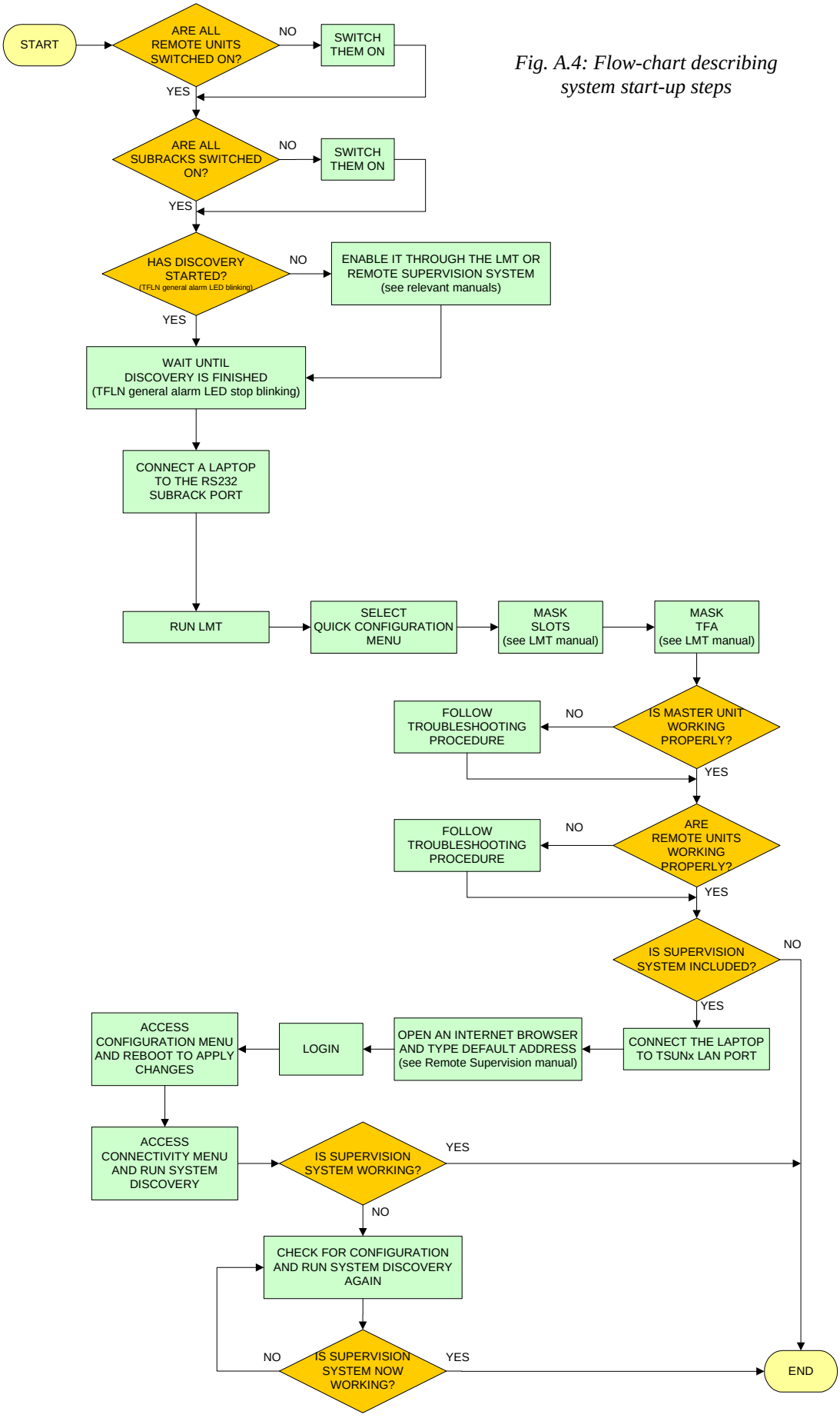


Fig. A.4: Flow-chart describing system start-up steps

Appendix B:
EU Guidelines
for WEEE disposal

All Britecell Plus products are properly labelled (please refer to fig. B.1) so as to inform the customer that no piece of equipment should be treated as unsorted municipal waste. Within the EU boundariers, any Britecell Plus equipment which is no longer used should be treated and disposed of according to European Directives 2002/96/EC and 2003/108/EC. The above regulations state that Waste Electric Electronic Equipment (WEEE) have to be disposed of by authorised centers with proper license for WEEE treatment.
The customer can decide to dispose of the unused equipment only if he owns a WEEE disposal licence. Otherwise, he should contact the manufacturer or any center which is authorised for WEEE treatment. Any failure to comply with the above regulations will be punished through a penalty whose amount and terms are set by each EU Member State.
The information reported hereinafter (table B.1) are aimed to provide the costumer and/or the WEEE treatment center with any information about recycling and disposing of the Britecell Plus equipment. These guidelines fall within Andrew's efforts to increase re-use, recycling and other forms of recovery, leading to a reduction in the amount of waste going to landfill or incineration.

Fig. B.1: WEEE Identification Label

Products	***Recyclable materials***	***Wastes to be disposed of by approved companies (licensees for European Waste No. 160216)***	***Hazardous materials***
TFAx Case A TFAx Case B	• Alluminium (external case) • Metal (RF connectors, screws, bottom cover) • Plastic (optical connectors and adapters)	• cables, fiberoptics cables, internal circuit boards • psu, inlet (for any TFAx Case A, except TFAM20)	• None
TPSN Power Supply	• Plastic (external case; inlet and plug in the 220 Vac version) • Metals (wall bearing; screws)	• Cables, internal circuit board	• Electrolytic capacitors

TFAH Case F	• Alluminium (external case) • Metal (RF connectors, screws, cavity filters) • Plastic (optical connectors and adapters ; power connector;)	• cables, fiberoptics cables, internal circuit boards, psu, inlet	• None
TFAH Case L	• Alluminium (external case; wall-fixing plates; pipe connection and PG 13,5 ; strain reliefs) • Metal (RF connectors, screws, cavity filters) • Plastic (optical connectors and adapters ; power connector;)	• cables, fiberoptics cables, internal circuit boards, psu, inlet	• None
TKA installation kit	• Alluminium (wall bearing)	• None	• None
TPRN	• Alluminium (external case) • Metal (screws, bottom cover) • Plastic (black guides housing the modules)	• cables, internal circuit boards, psu, inlet	• None
TFLN	• Alluminium (front panel) • Metal (RF connectors, screws) • Plastic (optical connectors and adapters ; side protections of the electronic board)	• cables, fiberoptics cables, internal circuit board	• None
TFLF	• Metal (RF connectors, screws) • Plastic (optical connectors and adapters ; side protections of the electronic board)	• cables, fiberoptics cables, internal circuit board	• None
TLCN2, TLCN4, TLDN,TLTN, TDPX, TMP	• Alluminium (front panel) • Metal (RF connectors, screws)	• cables, internal circuit board	• None
TBSI	• Alluminium (front panel) • Metal (RF connectors, screws) • Plastic (handles on the TBSI front panel)	• cables, internal circuit board	• None
TWLI	• Alluminium (front panel) • Metal (RF connectors, screws) • Plastic (buttons on the front panel)	• cables, internal circuit board	• None
TILx	• Alluminium (front panel) • Metal (RF connectors, screws) • Plastic (optical connectors and adapters ; side protections of the electronic board)	• cables, fiberoptics cables, internal circuit boards	• None

TRS / TRSN	• Alluminium (external case) • Metal (screws) • Copper (Transformers model with active distributions)	• cables, internal circuits, circuit breakers	• None
TSUN 6	• Alluminium (front panel) • Metal (screws)	• Internal circuit board	• None
TSUN 1 / TSUN 3	• Metal (screws, external case)	• Internal circuit board, psu, inlet	• None

Table B.1. Guidelines on recycling and disposing of Britecell Plus electrical and electronic equipment