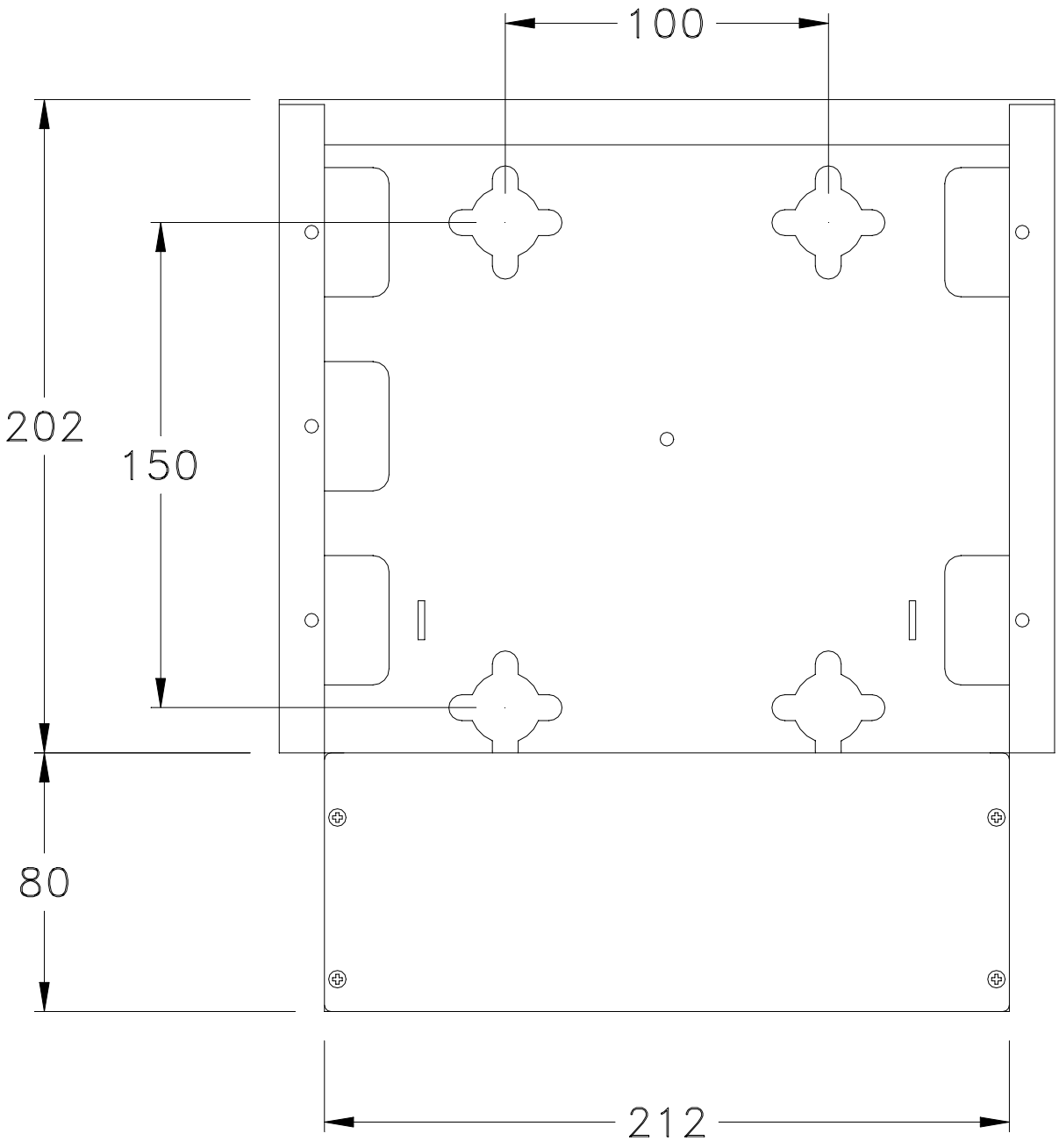


Fig. 8: TKA layout with quote for wall anchors

TFAxxx behaviour at system start-up

Before the TFAxxx remote unit is switched on, make sure that:

- the modules hosted by the Master unit have been connected each other with the RF jumpers, according to what has been planned in the system design
- every TFLN local unit has been connected to its remote units
- each remote unit has been connected to its coverage antennas

For a correct system start-up, all the remote units are to be switched on before the Master Unit.
For proper operations, the Master Unit can be turned on only when all the remote units are already on.

Once the TFAxxx has been switched on, its behaviour can be summarized in the following steps:

1. when the Remote Unit is turned on, both the LEDs upon the warm side turn on for a couple of seconds
2. After that, the unit green LED remains on (thus indicating proper power supply), while the red LED switches off as soon as the Master Unit is turned on (meaning that DL optical power is OK and no alarms are present).
3. Once the Master Unit has been switched on, the status of both LEDs have to be as reported in table 2. In case the red LED remains on, please refer to the troubleshooting section.

Led colour	*Status and Meaning*
Green	ON (when power supply is on)
Red	OFF (when no major failure affects TFAxxx operations)

Tab. 2: Status of TFAxxx LEDs in working conditions

4. After being switched on the remote unit starts working correctly. Anyway, in order to be recognized by the maintenance and supervision software, it is necessary for the corresponding TFLN local unit to carry out the discovery phase *(please refer to Supervision System Manual for more details)*. During this phase which can last at max. 4min, depending on the system complexity, the TFLN LED ⌐┘ blinks. ***Do not connect/disconnect any cable or any piece of equipment during the discovery phase!*** This may result in failing the identification of the remote unit.

TFAxxx troubleshooting

Faults can be revealed by LEDS on the TFAxxx front panel as well as by LMT or supervision system (running on the agent)
Both LMT and supervision system provide full information about the device causing the alarm. As a consequence, troubleshooting procedure can be very immediate when failure detection is directly carried out through LMT or supervision system.
Britecell Plus modules are designed in order to exchange information so that each remote unit can receive failure notifications from its external equipment (e.g. a TFBW booster) through dry-contact connections. Moreover, the TFAxxx constantly monitors the optical signal received from its TFLN unit to control optical losses.
The following table reports a brief description of alarms related to each remote unit, together with a reference to the corresponding alerted LEDs on the triple band remote unit front. Single band and dual band units have similar alarms, where applicable.

Alarm description	*Red LED status*	*Priority*
Failure on external equipment connected to dry-contact 1	On	High
Failure on external equipment connected to dry-contact 2	On	High
Internal power supply failure	On	High
Breakdown in communications inside the TFAxxx board	On	High
The optical power received on DL port is too low (ie, the AGC can no more compensate the optical losses on DL input signal)	On	High
The optical power received on DL port is near to critical level, but the system still works (ie, AGC still compensates losses)	No detection	Low
GSM DL power amplifier failure	On	High
DCS DL power amplifier failure	On	High
UMTS DL power amplifier failure	On	High
Too high TFAxxx temperature	No detection[1]	Low

Tab. 3: Alarm Description

[1]This temperature alarm can be revealed by supervision or maintenance software if the TFAxxx board overheats. Keeping environmental conditions between +5°C and +40°.is an important key factor to get a proper TFAxxx temperature.

As the table shows minor alarms (low priority alarms) are revealed only by LMT or supervision system, but not by LEDs. Minor alarms detect critical situations which should be checked and tested in order to avoid future possible system faults.

Each remote unit is provided with an AGC system which comes in after the optical-to-RF conversion. This AGC can correctly compensate optical losses when these are estimated to be < 3 dB. In case optical losses are in the 3dB- 4dB range, the whole system still works, but AGC is near to its borderline levels. The red LED switches on when the estimated optical losses are > 4dB, the AGC not being able to compensate these losses any more.
As shows in the previous table, the same red LED switches on to reveal any major failure. Following the troubleshooting procedure reported hereinafter it is possible to better understand what the problem is.

Main troubleshooting procedure
(The following procedure is summarized by the flow-chart in fig. 8)
In case the red LED is ON, please follow these steps:

1. first of all, refer to dry-contact troubleshooting, so as to understand whether the alarm can depend on any external equipment failure (e.g. a TFBW booster failure) or not.
2. in case dry-contact troubleshooting has not revealed any failure, clean the optical adapter
3. if the problem still persists, refer to the fibre optic UL troubleshooting in order to check if optical cables or optical connections have any problem on UL path.
4. if previous action didn't make the LED switch off replace the unit with a new one or contact for assistance.

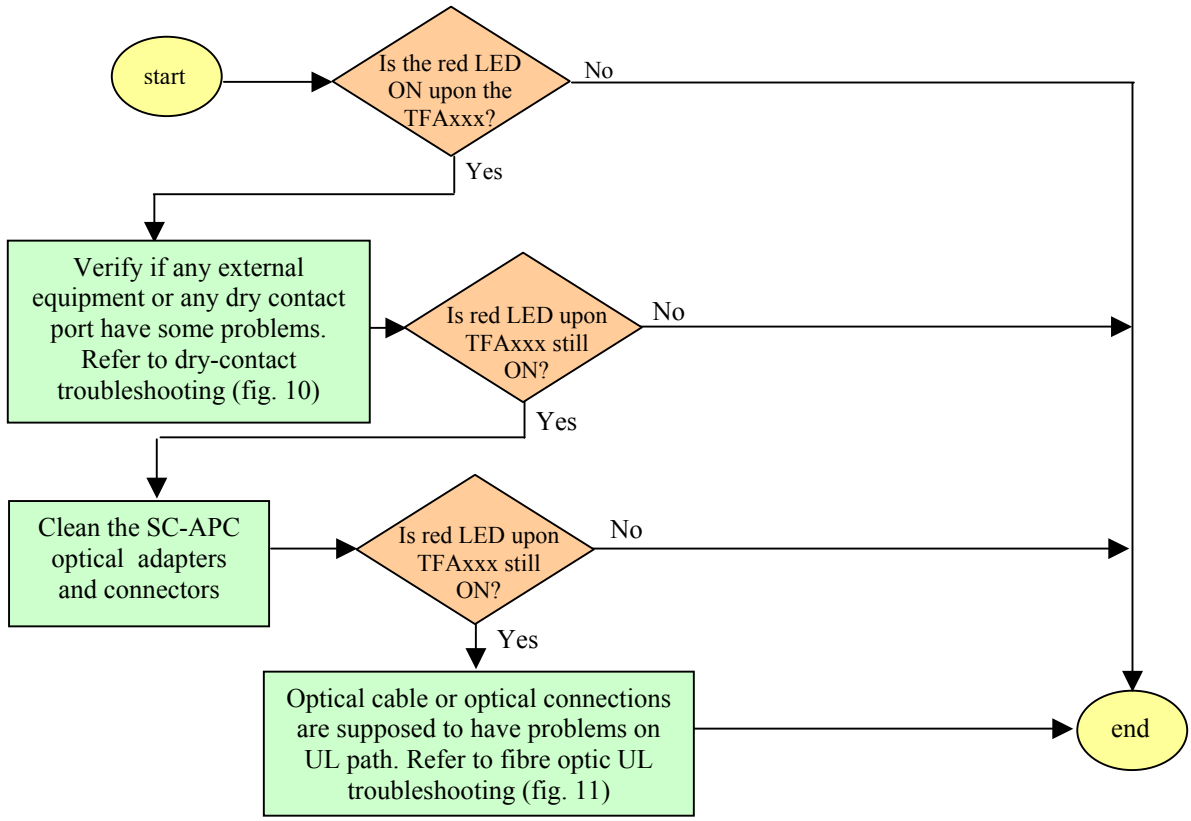


Fig. 9: Flow-chart describing the main troubleshooting procedure on TFAxxx

Dry contact troubleshooting

(The following procedure is summarized by the flow-chart in fig. 10)

This procedure needs to be considered if at least one TFAxxx dry-contact is connected to some external equipment. If not, return to main troubleshooting procedure.

Follow steps 1, 2 for each dry contact connected to any external equipment. These steps aim to detect any failure inside the external equipment or inside the dry-contact port. If dry-contacts don't reveal equipment malfunction or a port failure, return to the main troubleshooting procedure.

For any dry-contact connected to some external equipment, follow these steps:

1. Disconnect it, and check the TFAxxx LED status after the disconnection.
2. If the red LED has switched off, external equipment connected to the dry contact port should be faulty. Please test it.
3. If the TFAxxx red LED still remains on after the disconnection, measure voltage between the terminals of the dry contact port.
    a. If the terminals are electrically closed, the dry-contact port sis faulty. Contact the manufacturer for assistance.
    b. If the terminals are open, this means neither the analysis of the present dry contact nor the one of its external equipment has revealed failures. Re-connect the present dry contact port to its external equipment. In case the TFAxxx has another unchecked dry-contact connected to some external equipment, apply the whole procedure (ie steps 1-3) to this new port

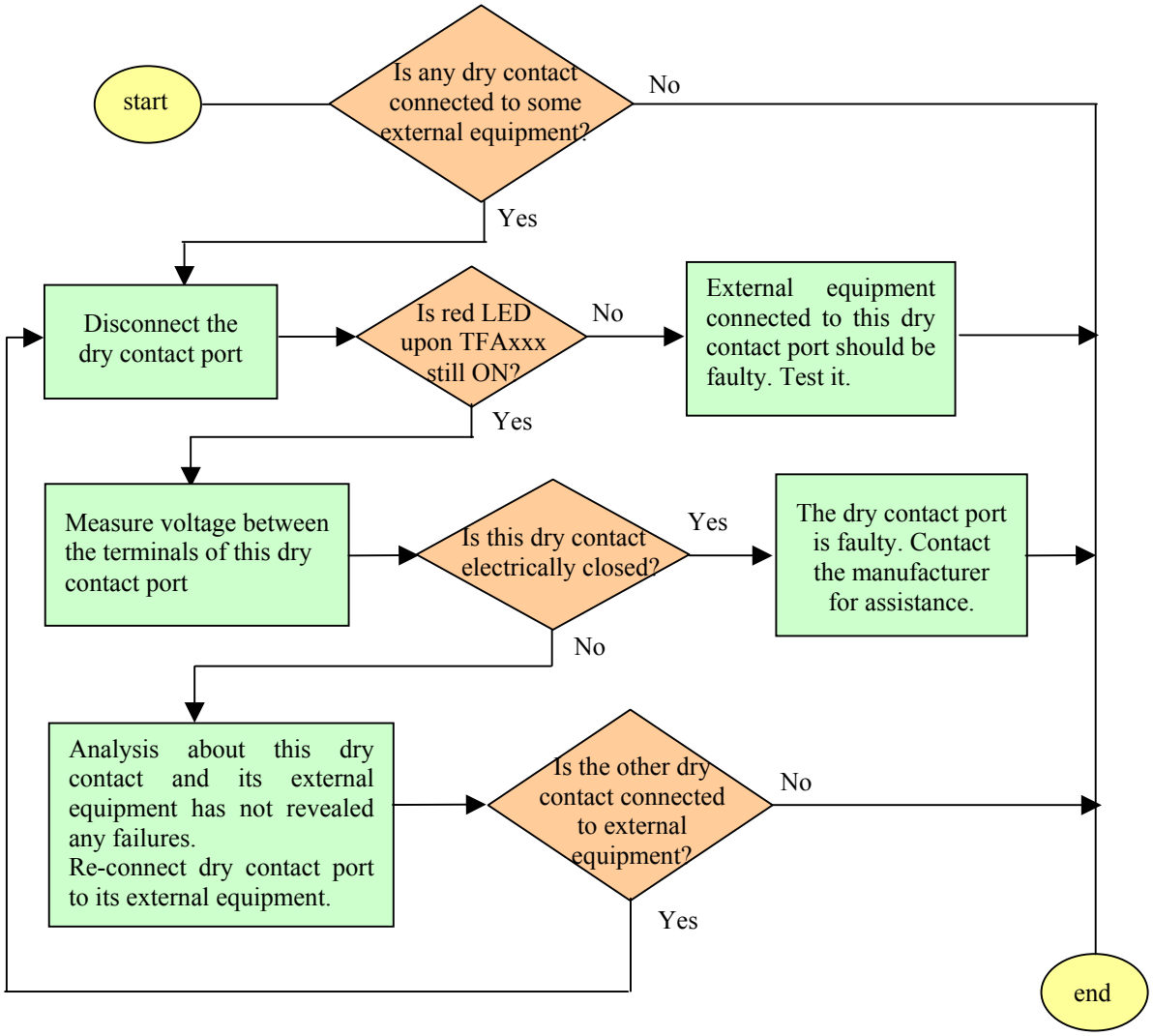


Fig. 10: Flow-chart describing the dry-contact troubleshooting.

Fibre optic UL troubleshooting

(The following procedure is summarized by the flow-chart in fig. 11)

- 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.
- Check if the SC-APC connectors are properly installed at both fibre ends (i.e. TFLN and TFAxxx ports). In case they are 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.
- Disconnect the optical fibre and clean it at both fibre ends (i.e. TFLN side and TFAxxx 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.
- Disconnect the optical SC-APC connector from TFLN UL port, and measure the *output power* $P_{out(UL)}$ at corresponding fibre end (i.e. the power coming out of SC-APC UL connector). Then, go to the TFAxxx side, disconnect the optical SC-APC connector from TFAxxx UL port and measure the *input power* $P_{in(UL)}$ coming out of the TFAxxx UL port (i.e. the optical power entering the fibre).
- Calculate the UL fibre attenuation A_{UL} as: $A_{UL}\ [dB] = P_{in(UL)} - P_{out(UL)}$
  - If $A_{UL} > 4dB$, the fibre optic cable has some problems or cable path is too long. Replace it.
  - If $A_{UL} < 4dB$, then TFAxxx remote unit should be faulty. Before replacing it, check the TFAxxx status on supervision system and contact for assistance.

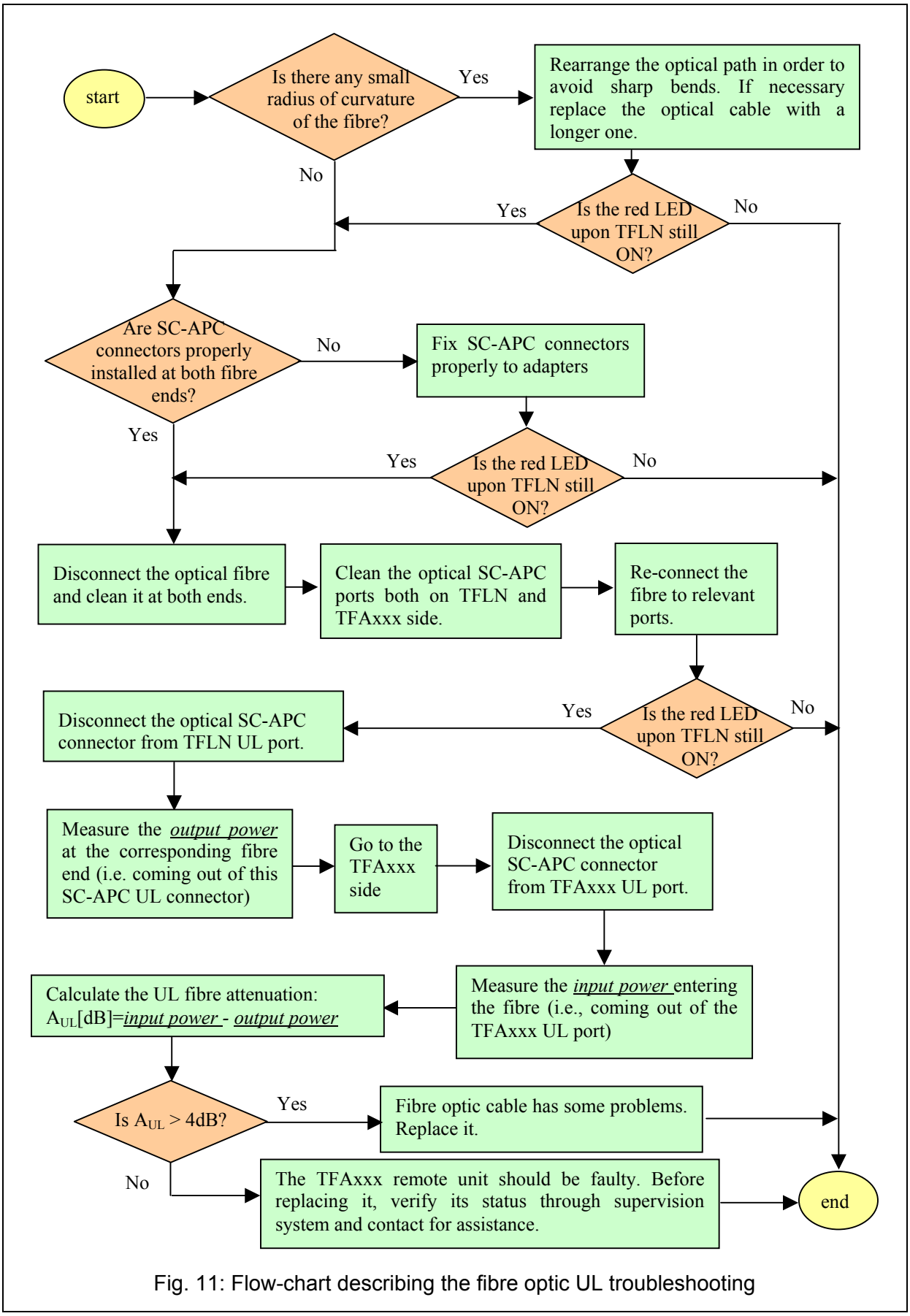
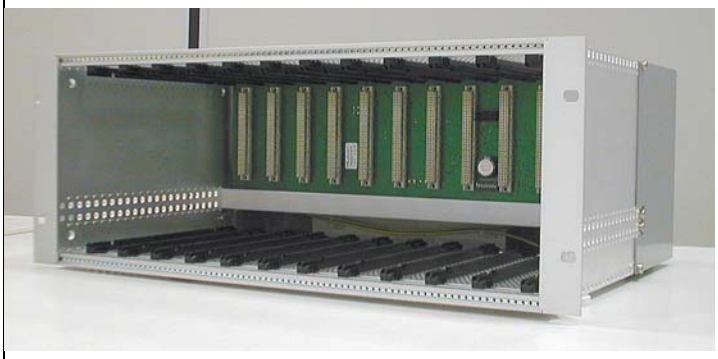


Fig. 11: Flow-chart describing the fibre optic UL troubleshooting

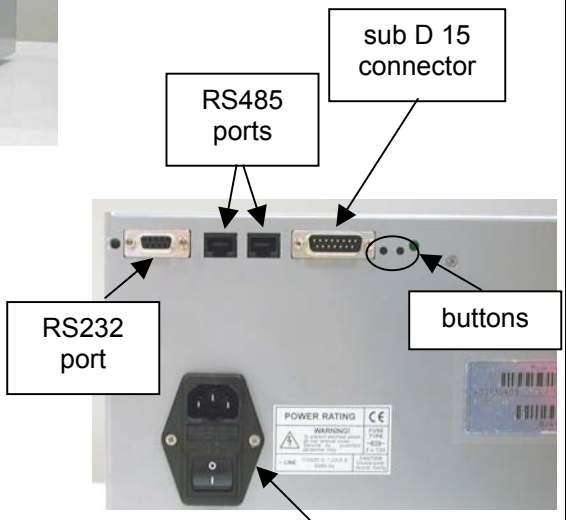
4. Master Unit

4.1. 19” Subrack TPRNxy

Name: **TPRN**	**Major TPRN features** The TPRNxy is a 19"subrack where all the Britecell Plus plug-in modules can be inserted. Britecell Plus equipment provides a wide variety of these subrack models, differentiated by power supply and by communication ports placing. Each one is provided with: • 12 free slots, each with Height=4HE, Width=1HE • Power supply 220 Vac or -48 Vdc • Locally or remotely connectible 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.



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



Front view of the TPRN sub-rack with power supply and/or communication ports on the front through TFM board

TFM board allowing communication ports and power supply (according to relevant versions) on the front of the subrack.

TPRN models

A brief description of all the available TPRN master units is reported hereinafter.

Passive subrack (TPRN04)

- TPRN04 is a passive subrack. 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-subrack system, in case the customer decides to put all the active modules in an active subrack, to be chosen among the following ones.

220 Vac powered TPRNs (TPRN14 / TPRN24 / TPRN14F / TPRN24F)

- TPRN14 is an active subrack designed to be fed through 220 Vac universal mains. Both the connector for 220Vac power supply and the communication ports are placed on the subrack rear. The 220 Vac power supply is not redundant (ie, no spare adapter is provided).
- TPRN24 is an active subrack designed to be fed through 220 Vac universal mains. Both the connector for 220Vac power and the communication ports are placed on the subrack 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.
- TPRN14F is an active subrack designed to be fed through 220 Vac universal mains. The connector for 220Vac power supply is on the subrack rear, while the communication ports are on a TFM module, inserted in the 12th master unit slot. The 220 Vac power supply is not redundant (i.e. no spare adapter is provided).
- TPRN24F is an active subrack designed to be fed through 220 Vac universal mains. The connector for 220Vac power supply is on the subrack rear, while the communication ports are on a TFM module, inserted in the 12th master unit slot. 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 TPRNs (TPRN34 / TPRN34F)

- TPRN34 is an active subrack designed to be fed through –48 Vdc negative supply. Both the connector for -48Vdc power supply and the communication ports are placed on the subrack rear.
- TPRN34F is an active subrack designed to be fed through –48 Vdc negative supply. Both the connector for –48 Vdc power supply and the communication ports are on a TFM module, occupying the 12th master unit slot. This allows an easier maintenance, in case the -48 Vdc power supply has a breakdown.

TPRN power supply

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

Universal mains

(85 ÷ 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 both the green LED on TPRN panel and the supervision system detect the failure).

Fig. 12: 85÷264Vac connector

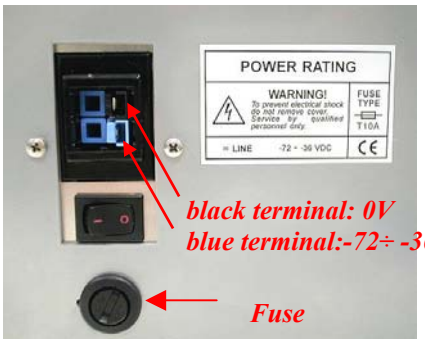


Fig. 13: -72÷-36Vdc connector

Fig. 14: 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 subrack is provided with a set of I/0 ports which allow the connection to any external device. All these ports (RS232, RS485, sub-D 15 pin male connector) can be placed both on TPRN back and on TPRN front, depending on chosen version.

RS232 serial port

The RS232 serial port can be used to connect the TPRN subrack to the agent.

The connection baud rate can be set to 9600 bps or 19200 bps, by properly setting the dip-switch 5 standing on the interior TPRN backplane (see fig. 15). The baud-rate setting through dip-switch 5 is shown in table 4.

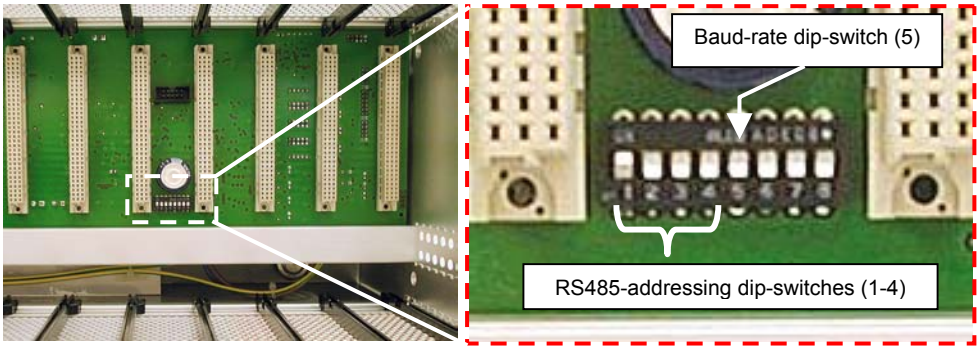


Fig. 15: Dip-switches on TPRN backplane.

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

Tab. 4: 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 agent
- 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 RJ-45 connectors, which work as input and output ports towards a RS485 bus.

This RS485 bus has to be used in order to connect a multi-subrack system to the agent. In this case:

- the TPRN subracks have to be connected one another via RS485 bus;
- In order to monitor the whole system, the agent has to be connected to one of the TPRN subracks through RS232 port.

Before connecting one another the TPRN subracks belonging to a multi-subrack 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.

The binary address assignment can be done through dip-switches 1,2,3,4, which stand on interior TPRN backplane (see figure 15). A list of the correspondences between the addresses and the dip-switches is provided by table 5: 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

Tab. 5: Dip-switches address settings

The baud rate of the RS485 ports is the same of the RS232 port as per the setting of dip-switch 5 (see before)

Whichever baud rate you choose, remember that:

- the same RS485 connection speed has to be set up on all the connected device (TPRN subracks or TSUN);
- 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 pins male connector

The TPRN subrack provides a sub-D 15 pins male connector, shown in fig. 4.17.

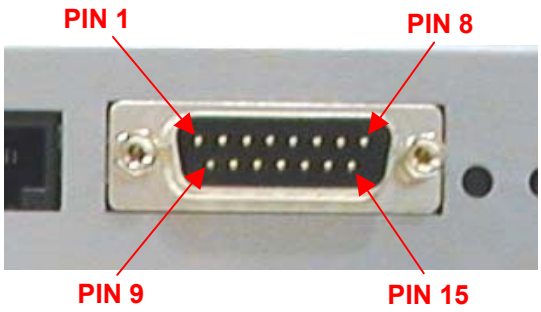


Fig. 16: sub-D 15 pin male connector

This connector provides:

- 4 optoisolated input ports which can be used to reveal any failure on remote 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 and cause the corresponding Auxiliary Input LED to switch on upon the TFM board (on TPRN front panel)
- a summary of major and minor alarms related to failures detected not only on the TPRN subrack, but also on any active module 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 is reported in table 6. The pins are numbered from left to right, and from top to bottom (refer to fig. 16).

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 causes the Auxiliary Input LED 1 to switch on upon the TFM board.
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 causes the Auxiliary Input LED 2 to switch on upon the TFM board.
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 subrack or on any module hosted by it.
7,8	Summary of minor alarms	These pins present an open circuit if a minor alarm is active on the TPRN subrack or on any module hosted by 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 causes the Auxiliary Input LED 3 to switch on upon the TFM board
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 causes the Auxiliary Input LED 4 to switch on upon the TFM board
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. 6: Functional description of pins provided by sub D male connector.

Note: The TPRN subrack 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 subrack but also to any hosted module.

TPRN visual alarms (where available)

A full description of all TPRN alarms is provided by the Supervision system. All TPRN subracks including a TFM board (i.e. TPRN14F, TPRN24F, TPRN34F models) also provide alarm monitoring through the LED front panel (see fig. 17).

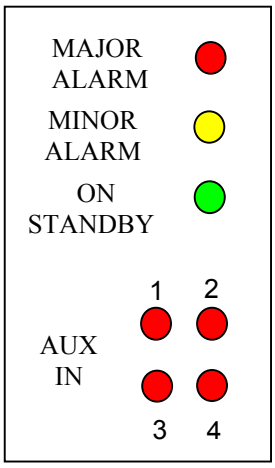


Fig. 17: LED panel on TFM board

Label	*LED colour*	*Meaning*
MAJOR ALARM	Red	ON when a major alarm is detected on TPRN
MINOR ALARM	Yellow	ON when a minor alarm is detected on TPRN
ON STANDY	Green	ON when TPRN is on
1	Red	ON if any external alarm is detected through the input port 1 of sub D connector.
2	Red	ON if any external alarm is detected through the input port 2 of sub D connector.
3	Red	ON if any external alarm is detected through the input port 3 of sub D connector.
4	Red	ON if any external alarm is detected through the input port 4 of sub D connector.

Tab. 7: alarm description

Major and minor LED alarms upon TFM board refer only to major and minor failures on the TPRN itself and do not detect any fault on the hosted modules.

Note: Being able to collect module status through I2Cbusl, the TPRN also knows any alarm information about the hosted modules. However, as each active module controls its internal failures through its own LEDs panel, the LEDs upon TPRN subrack only refer o its circuitry.

Auxiliary input LEDs reveal an alert condition when corresponding pins recognize any alarm on the external device connected through sub D 15 connector.

Warning (recommended for system designing and installing)

Providing a correct heat dissipation

For a correct use of the TPRN subrack, it is important to verify that:

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

- a passive subrack (TPRN04) may be used to house only passive modules;
- an active subrack (TPRN14, TPRN14F, TPRN24, TPRN 24F, 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 subrack).

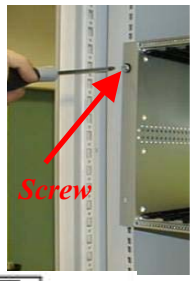
Setting the dip-switches in a multi-subrack system

If you are installing a multi-subrack system, remember to assign each subrack an exclusive binary address, by properly setting dip-switches 1,2,3,4 on the interior TPRN backplane (see fig. 15 and tab.5). Dip-switch 5 has to be set on each TPRN subrack in order to fix the baud rate for RS485 and RS232 port. Connecting TPRNs through RS485 port is necessary when supervising the whole multi-subrack system through the SNMP agent which has also to be set at the same baud rate.

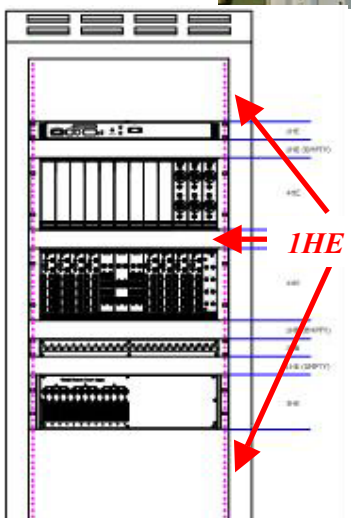
TPRN Installation

The TPRN kit provides:

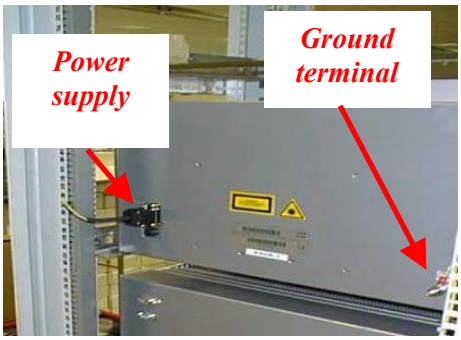
- 1 Sub rack TPRN



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



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



TPRN behaviour at system Start-up

Before switching on the TPRN subrack, 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 TFAxxx remote units
- each TFAxxx remote unit has been connected to its coverage antennas
- the agent (if present) has been connected/housed to/into the Master Unit
- different subracks have been connected each other via bus RS485 and each of them should have different addresses
- the rack housing the TPRN is large enough to leave a minimum distance of 1HE between contiguous TPRN subracks

Remember that TFAxxx remote units have to be switched on before relevant Master Unit. Only when all the TFAxxx remote units are on, the Master Unit can be turned on.

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

1. when TPRN subrack is turned on, all seven LEDs upon the TPRN front panel (provided that TPRN is equipped with a TFM board) go on for a couple of seconds
2. After that, the green LED remains ON (indicating proper power supply), while the other LEDs indicate the remote units status, according to the following table 8

Note: Some of the AUX IN LEDs 1, 2, 3, 4 can remain ON if the corresponding input statuses are wrongly associated to external equipment working condition. In this case, once the step 4 has finished, remember to properly set the default status by the supervision system.

3. About 10sec after the TPRN subrack 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 TFAxxx remote units. While the discovery phase is working (at 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 the TFLN modules have finished the discovery phase. This may result in failing the identification of TFAxxx. Anyway during the discovery phase, the whole system can still work correctly as discovery process aims to collect information about TFAxxx but doesn't affect the basic working of the system.

Label	*LED colour*	*Status*
ON STANDY	Green	ON (when power supply is on)
MAJOR ALARM	Red	OFF (if no major alarm is detected on TPRN subrack)
MINOR ALARM	Yellow	OFF (if no minor alarm is detected on TPRN subrack)
1	Red	OFF (if no external alarm is detected through the input port 1 of the sub D 15 pin connector)
2	Red	OFF (if no external alarm is detected through the input port 2 of the sub D 15 pin connector.
3	Red	OFF (if no external alarm is detected through the input port 3 of the sub D 15 pin connector)
4	Red	OFF (if no external alarm is detected through the input port 4 of the sub D 15 pin connector)

Tab. 8: subrack LED status in full-working condition.

4. 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 local unit is not affected by a general failure).

TPRN troubleshooting

In case a TPRN subrack shows any problem, this will be revealed through LEDs upon TPRN front panel. A more detailed status and alarm description could be provided through the SNMP agent.

It should be noted that TPRN minor and major alarm LEDs just refer to TPRN subrack itself and detect errors on TPRN circuitry, but do not signal alert situations on the hosted active modules Active modules are monitored by their own LED panels.

A complete overview of TPRN alarms is reported in the following table.

Alarm description	*LED*	*LED colour*
Redundant power supply active	Minor alarm LED	Yellow
+12V degradation	Major alarm LED	Red
I^2Cbus error	Minor alarm LED	Yellow
Temperature out of range	Minor alarm LED	Yellow
Alarm revealed on auxiliary input port 1	AUX IN LED 1	Red
Alarm revealed on auxiliary input port 2	AUX IN LED 2	Red
Alarm revealed on auxiliary input port 3	AUX IN LED 3	Red
Alarm revealed on auxiliary input port 4	AUX IN LED 4	Red

Tab. 9: Brief description of alarms detected through TPRN LED panels.

Red major alarm LED refers to power supply degradation and switches on in case the +12Vdc power falls below a threshold level in factory set. In this case, TPRN automatically turns to standby mode so that alarm LED remains on while 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 subrack is equipped with a redundant power supply (TPRN24, TPRN24F), a degradation of the +12 Vdc power results in an automatic switching from main to spare converter and yellow minor alarm LED switches on to highlight that the redundant power supply is active. In case also redundant power supply degrade the TPRN automatically turns to stand-by mode and major alarm red LED switches on to signal no-working situation. Once the power supply has been repaired the TPRN needs to be rebooted.

I2Cbus alarm is a minor alarm which turns on when TPRN subrack cannot communicate with one or more hosted module. Each TPRN slot is provided with 2 pins, which 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 I2Cbus the minor alarm LED switches on.

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 case one of TPRN LED alarms switches on please refer to the troubleshooting procedure reported hereinafter to recognize the failure. This procedure is valid in case the TPRN includes the TFM module showing LEDs on the front panel otherwise please check LMT or supervision system handbooks.

TPRN main troubleshooting procedure

(The following troubleshooting procedure is summarized by the flow-chart in fig. 18)

- When the TPRN is correctly supplied, the green LED on TFM board is switched on. In case the TPRN does not switch on, check the fuse upon the power supply connector. If it is burned, just replace it with a new one, and restart the TPRN. If it is not, the power supply system may be faulty, contact the manufacturer for assistance.
- In case the major alarm LED (red LED) is on, the system experiences power supply degradation. In this case, the TPRN automatically has turned to stand-by mode, in order to preserve the internal circuitry from over-current. Contact the manufacturer for assistance.
- In case the minor alarm LED (yellow LED) is on, please refer to Minor Alarm Troubleshooting reported in the following.
- In case any AUX IN LED (red LED) is on, an alarm condition is revealed through the corresponding input port of sub D 15 pin connector, if any external device has been connected to the TPRN master unit through sub D port, it may have some problems. Test it. If you do not detect any failure on external device, the input port of subD-15 connector shouldn't have been set to the correct default status through the supervision system.

Minor alarm troubleshooting

(The following troubleshooting procedure is summarized by the flow-chart in fig. 19)

- In case the TPRN is provided with a redundant power supply, the main power supply may have failed. Check the fuse, and replace it if burned.
- If the minor alarm LED is still on, disconnect one module at a time from the TPRN backplane. After having disconnected each module, check if the minor alarm LED is still one.
    - In case the yellow LED switches off after disconnecting any card, the disconnected module may be faulty. Test it or contact the manufacturer for assistance.
    - If the minor alarm LED remains still on, the TPRN may have problems either in internal I2Cbus communications or in overheating. Contact manufacturer for assistance.

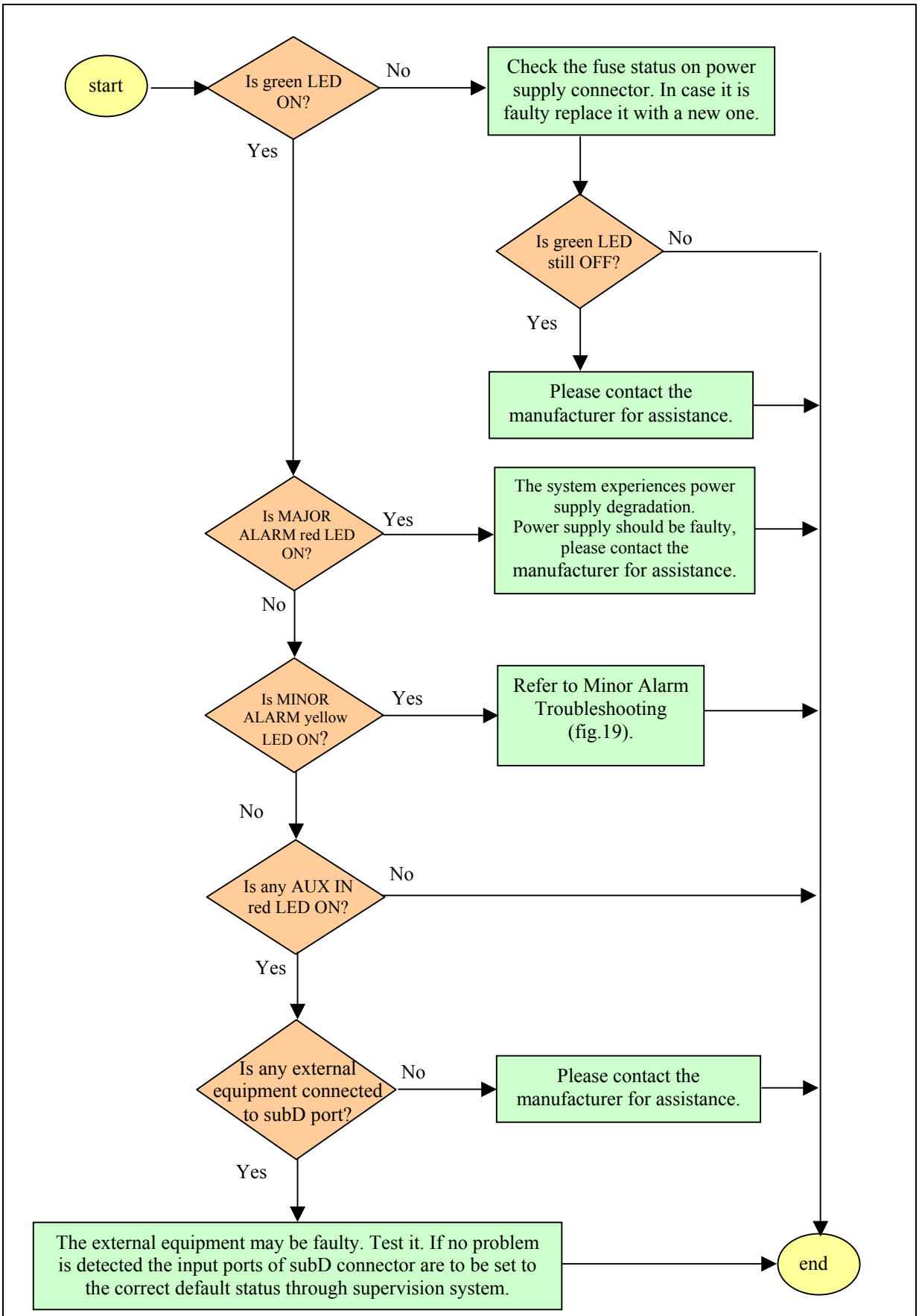


Fig. 18: Flow-chart for TPRN main troubleshooting procedure

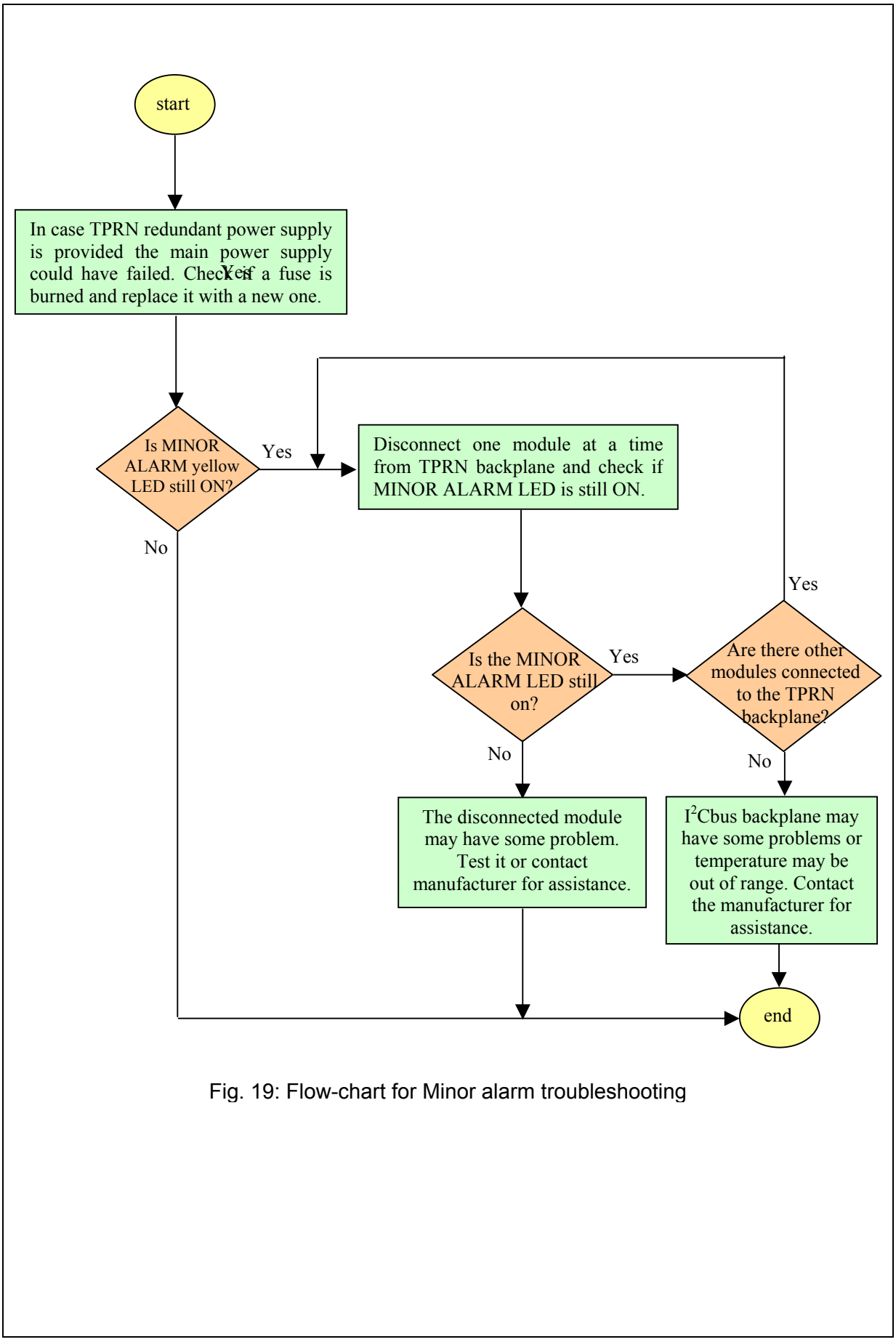
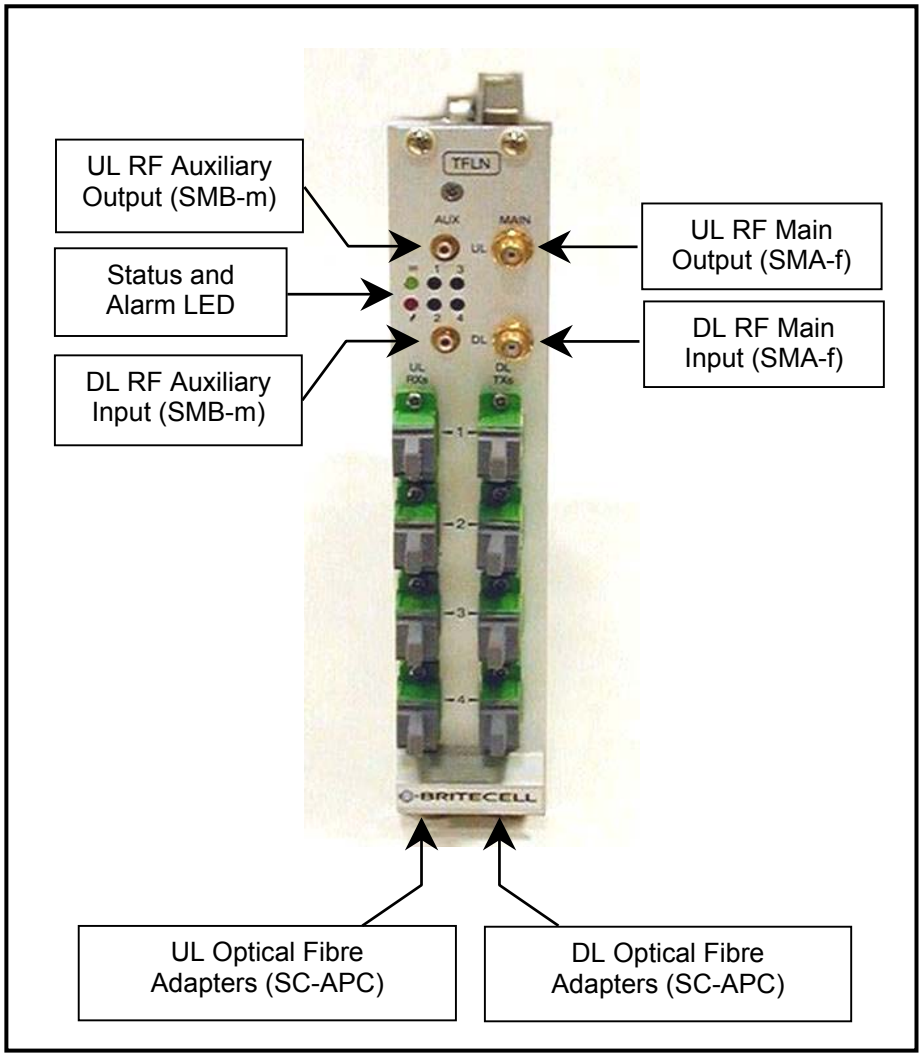


Fig. 19: Flow-chart for Minor alarm troubleshooting

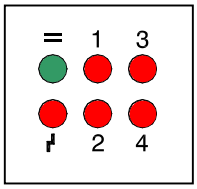
4.2. Local Unit TFLN

Module name: **TFLN**	**Main processes carried out by the TFLN module** ➢ In Downlink (DL) operations: • RF-to-optical conversion of the input RF signal • Optical splitting: input RF signal is split onto 4 optical outputs ➢ In Uplink (UL) operations: • Optical-to-RF conversion of the 4 input optical signals • Automatic Gain Control (AGC) of each converted signal to compensate optical losses (provided they are < 4dB); • RF combining of the 4 adjusted signals into a single RF output
RF ports ➢ 1 DL RF input port ➢ 1 auxiliary DL RF input port, dedicated to WLAN services ➢ 1 UL RF output port ➢ 1 auxiliary UL RF output port, dedicated to WLAN services Note: nominal input levels at RF port require a maximum input RF power. of 3dBm (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).



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. 10: summary of TFLN LED meanings.

TFLN power supply

Each TFLN local unit is supplied by the subrack back-plane (12V).
The power consumption of each TFLN local unit is 9W.

Warnings (to be read before the TFLN installation)

Dealing with optical output ports

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

Handling optical connections

- When inserting an optical connector, take care to handle it so smoothly that the optical fibre is not damaged. Optical fibres have to be single-mode (SM) 9.5/125µm.
- Typically, Britecell Plus equipment is provided with SC-APC optical connectors. As an alternative, FC-APC connectors may be provided. Inserting any other connectors will result in severe damages.
- Do not force or stretch the fibre pigtail with radius of curvature less than 5 cm. See fig. 20 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

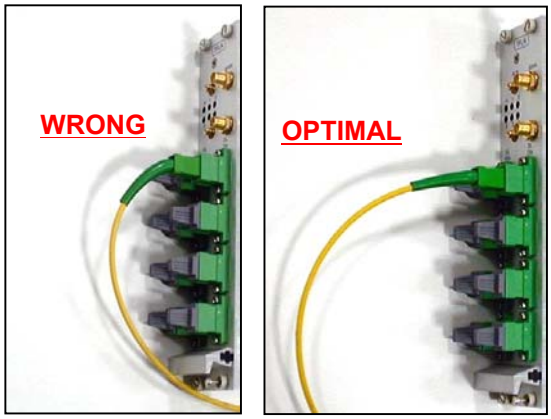


Fig. 20: Fibre Optic bending

Inserting or removing TFLN modules

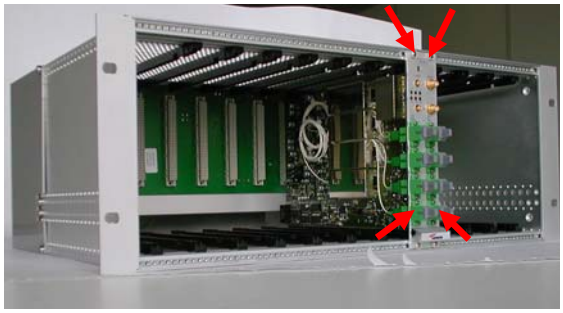
- Do not remove or insert any TFLN module into TPRN subrack before having switched off main power supply.
- The TFLN modules must be handled with care, in order to avoid damage to electrostatic sensitive devices.
- When installing TFLN modules in the subrack, take care to alternate active and passive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

TFLN positioning in system design

- In case no ventilation system is installed, do not insert more than 8 active modules into a subrack.
- In case more than 8 active cards have to be housed into the TPRN subrack, it's advisable to install the TPRN subrack 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 causing damages in Britecell Plus circuitry or increase of spurious emissions.

TFLN installation

The TFLN local unit is housed in a TPRN subrack 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 subrack 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.