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ED	**DATE**	**CHANGE NOTE**	**APPRAISAL AUTHORITY**	**ORIGINATOR**

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HANDBOOK GUIDE

1 HANDBOOK STRUCTURE AND CONFIGURATION CHECK

1.1 General information

ALCATEL makes no warranty of any kind with regards to this manual, and specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. ALCATEL will not be liable for errors contained herein or for damages, whether direct, indirect, consequential, incidental, or special, in connection with the furnishing, performance, or use of this material.

NOTICE

The product specification and/or performance levels contained in this document are for information purposes only and are subject to change without notice. They do not represent any obligation on the part of ALCATEL.

COPYRIGHT NOTIFICATION

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1.2 Handbook applicability

This handbook applies to the following product-releases:

PRODUCT			ANV P/N
1626 LM			3AL 94201 AAAA
PRODUCT	**RELEASE**	**VERSION (N.B.)**	**ANV P/N**
1626 LM	2.0	–	3AL 94203 AAAA

N.B. See **NOTES FOR HANDBOOKS RELEVANT TO SOFTWARE APPLICATIONS** in para. 6.4.1 on page 50.

1.3 Product-release handbooks

The list of handbooks given here below is valid on the issue date of this Handbook and can be changed without any obligation for ALCATEL to update it in this Handbook.

Some of the handbooks listed here below may not be available on the issue date of this Handbook.

The standard Customer Documentation in the English language for the equipment whose product-release-version is stated on the manual’s front page consists of the following handbooks:

Table 1. Handbooks related to the product’s hardware

REF	HANDBOOK	ANV Part No.	FACTORY Part No.	THIS HDBK
[1]	1626 LM Rel.2.0 Technical Handbook	3AL 94936 AAAA	————	
	Provides information regarding Equipment description, Maintenance, Hardware setting documentation.			
[2]	1626 LM Rel.2.0 Installation Handbook	3AL 94936 CAAA	————	
	Provides stepped procedural instructions for unpacking, inspecting, Alcatel Part Number assembling, and mounting and wiring bays, sub–frames, I/O panels, ancillary items, and cabling.			
[3]	1626 LM Rel.1.2 Turn–On & Commissioning Handbook	3AL 94936 DAAA	————	
	Provides procedures to support visual inspection, module installation, Alcatel Part Number and provisioning; and local network element verification tests and generic network tests.			

Table 2. Handbooks related to the specific product SW management and local product control

REF	HANDBOOK	ANV Part No.	FACTORY Part No.	THIS HDBK or note
[4]	1626 LM Rel.1.2 Operator’s Handbook	3AL 94936 BAAA	————	
	Provides information regarding maintenance using the craft terminal			

Table 3. Handbooks common to Alcatel Network Elements using 1320CT platform

N.B. 1320CT and Q3CT–P are equivalent terms

REF	HANDBOOK	ANV Part No.	FACTORY Part No.	THIS HDBK
[5]	1320CT 3.X Basic Operator's Handbook	3AL 79551 AAAA	957.140.042 N	
	Provides general information and operational procedures common to all 1320CT (Craft terminal) of Alcatel Info–Model Network Elements.			
[6]	1330AS Rel.6.5 Operator's Handbook	3AL 88876 AAAA		
	Provides detailed information and operational procedures regarding the alarm Surveillance software embedded in the 1320CT software package.			
[7]	ELB Rel. 2.X Operator's Handbook	3AL 88877 AAAA		
	Provide detailed information and operational procedures regarding the Event Log Browser software embedded in the 1320CT software package.			

Table 4. Documentation on CD–ROM

See para.6.5 on page 51

REF	CD–ROM TITLE	ANV Part No.	FACTORY Part No.
[8]	1626 LM Rel. 2.0 CD–ROM–DOC EN	3AL 94937 AAAA	————
	Contains, in electronic format, the following handbooks: REF. [1] to [4] Also contains the product–release Help–On–Line which provides information regarding Craft Terminal screens and operational procedures, this documentation is provided in HTML fromat. Envisaged after the release of all handbooks		
[9]	1320CT 3.X CD–ROM–DOC EN	3AL 79552 AAAA	417.100.032
	Contains, in electronic format, the following handbooks: REF. [5] to [7] Envisaged after the release of all handbooks		

Table 5. Manuals relative to other equipment required for system realization

REF	HANDBOOK	ANV Part No.	FACTORY Part No.	THIS HDBK
	1640 WM Rel. 3.2 Technical Handbook EN	3AG 23411 ACAA	————	
	Provides information regarding Equipment description, Maintenance, Hardware setting documentation.			
	OCP Rel. 1.0 Technical & Operator's Handbook EN	3AL 94010 AAAA	————	
	Provides information regarding Equipment description, Maintenance, Hardware setting documentation, Craft Terminal screen and operational procedures.			

1.4 Handbook Structure

This handbook has been edited according to the Alcatel standardized "drawing–up guides" complying with such suggestion.

This handbook is divided into the following main topics as described in the table of contents:

HANDBOOK GUIDE:	It contains general information on safety norms, EMC and type of labels that might be affixed to the equipment. Furthermore, it describes the handbook structure and the customer documentation. The abbreviation list is supplied too.
DESCRIPTION:	It contains all the equipment's general and detailed system features including its application in the telecommunication network. Furthermore, it supplies the equipment description and specifications (i.e., system, mechanical, electrical and/or optical).
MAINTENANCE:	It contains all the details for periodic checks, fault location and repair procedures and restore to normal operation through the withdrawal of faulty units and their replacement with spares **(*)**
APPENDICES:	Section envisaged (but not necessarily included) to describe possible alternative unit.
HARDWARE SETTING DOCUMENTATION:	It encloses the documents related to unit hardware setting operations, if envisaged.
ANNEXES:	Section envisaged (but not necessarily included) containing additional documentation or general information on other topics not inherent to the chapters making up the handbook.

(*) If the equipment is software integrated and man–machine interfaced (through a PCD, PC, Work Station or other external processing/displaying system) the maintenance carried out with such system is described in the Operator's Handbook (see para.1.3 on page 12)

1.5 Handbook configuration check

1.5.1 List of the editions and modified parts

The following table indicates the handbook parts new and modified with respect to the previous edition.

Legenda

n = new part **p** =proposal part
m = modified part **PR** =proposal edition

Table 6. Handbook configuration check

	EDITION	01	02	03	04	05	06
DESCRIPTION		n					
1.	GENERAL	n					
2.	PHYSICAL CONFIGURATION	n					
3.	FUNCTIONAL DESCRIPTION	n					
4.	UNITS DESCRIPTION	n					
5.	TECHNICAL SPECIFICATION	n					
MAINTENANCE		n					
6.	MAINTENANCE	n					
APPENDICES							
	Nothing envisaged						
HARDWARE SETTING DOCUMENTATION		n					
	Unit documentation list	n					
ANNEXES							
	Nothing envisaged						

Note: the edition of the enclosed documents (sections **HARDWARE SETTING DOCUMENTATION** and **ANNEXES**) is not subjected to configuration check.

1.5.2 Notes on Ed.01

Ed.01 proposal created on November 2004 is the first neither validated nor officially released issued of this handbook.

2 COMPLIANCE WITH EUROPEAN NORMS.

2.1 Electromagnetic Compatibility (EMC)

The CE markings printed on the product denote compliancy with the following Directives:

- 89/336/EEC of May 3rd, 1989 (EMC Directives), amended
  - by the 92/31/EEC Directive issued on April 28th, 1992
  - by the 93/68/EEC Directive issued on July 22nd, 1993

Compliancy to the above Directives is declared, when the equipment is installed as for the manufacturer handbooks, according to the following European Norms:

- **EN 300 386** (**V1.3.1), environment "Telecommunication center"**

WARNING

This is a class A product of EN 55022. In domestic, residential and light industry environments, this product may cause radio interference in which case the user may be required to take adequate measures.

2.2 Safety

Compliancy to Safety Norms is declared in that the equipment satisfies standardized Norms :

• IEC 60950–1 ed. 2001 ,	for electrical safety
• EN 60950–1 ed. 2001 ,	for electrical safety
• EN 60825–1 ed. 1994 + A11 ed. 1996 + A2 ed. 2001	for optical safety
• IEC 60825–1 ed. 1993 + A2 ed. 2001 (1999)	for optical safety
• EN 60825–2 ed. 2000	for optical safety
• IEC 60825–2 ed. 2000	for optical safety

3 SAFETY NORMS AND LABELS

3.1 First aid for electric shock

Do not touch the patient with bare hands until the circuit has been opened.

Open the circuit by switching off the line switches. If that is not possible, **protect yourself with dry material** and free the patient from the conductor.

ARTIFICIAL RESPIRATION

It is important to start mouth to mouth resuscitation at once and seek medical help immediately.

TREATMENT OF BURNS

This treatment should be used after the patient has regained consciousness. It can also be employed while the artificial respiration is being applied (in this case there should be at least two persons present).

WARNING:

- **Do not attempt to remove his clothing from the burnt parts;**
- **Apply dry gauze on the burns;**
- **Do not apply ointments or other oily substances.**

Mouth to mouth resuscitation method

1	Lay the patient supine with his arms parallel with the body, if the patient is laying on an inclined plane, make sure that his stomach is slightly lower than his chest. Open the patient’s mouth and check that there are no extraneous bodies in his mouth (dentures, chewing–gum etc.),	
2	Kneel beside the patient level with his head. Put a hand under the patient’s head and one under his neck (see fig.) **Lift the patient’s head and let it recline backwards as far as possible**	
3	Shift the hand from the patient’s neck to is chin: place your thumb between his chin and his mouth, the index along his jawbone, and keep the other fingers closed together (see fig.). While performing these operations take a good supply of oxygen by taking deep breaths with your mouth open.	
4	With your thumb between the patient’s chin and mouth keep his lips together and blow into his nasal cavities (see fig.)	
5	While performing these operations observe if the patient’s chest rises (see fig.) If not it is possible that his nose is blocked: in that case open the patient’s mouth as much as possible by pressing on his chin with your hand, place your lips around his mouth and blow into his oral cavity. Observe if the patient’s chest heaves. This second method can be used instead of the first even when the patient’s nose is kept closed by pressing the nostrils together using the hand you were holding his head with. **The patient’s head must be kept sloping backwards as much as possible.**	
6	Start with ten rapid expirations, hence continue at a rate of twelve/fifteen expirations per minute. Go on like this until the patient has regained consciousness, or until a doctor has ascertained his death.	

3.2 Safety Rules

3.2.1 General Rules

- Before carrying out any installation, turn–on, tests & operation and maintenance operations carefully read the relevant Handbooks and chapters.
- Observe safety rules
  - When equipment is operating nobody is allowed to have access inside on the equipment parts which are protected with Cover Plate Shields removable with tools
  - In case of absolute need to have access inside, on the equipment parts when it is operating this is allowed exclusively to service personnel, where for Service Personnel or Technical assistance is meant :

    ”personnel which has adequate Technical Knowledge and experience necessary to be aware of the danger that he might find in carrying out an operation and of the necessary measurements to reduce danger to minimum for him and for others”.

    The Service Personnel can only replace the faulty units with spare parts.
    The Service Personnel is not allowed to repair: hence the access to the parts no specified is not permitted.

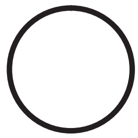
    The keys and/or the tools used to open doors, hinged covers to remove parts which give access to compartments in which are present high dangerous voltages must belong exclusively to the service personnel.
  - For the eventual cleaning of the external parts of the equipment, absolutely do not use any inflammable substance or substances which in some way may alter the markings, inscriptions ect.
  - It is recommended to use a slightly wet cleaning cloth.
- The Safety Rules stated in the handbook describe the operations and/or precautions to observe to safeguard service personnel during the working phases and to guarantee equipment safety, i.e., not exposing persons, animals, things to the risk of being injured/damaged.
- Whenever the safety protection features have been impaired, REMOVE POWER.
  To cut off power proceed to switch off the power supply units as well as cut off power station upstream (rack or station distribution frame).
- Unless fitted into the equipment, an external protection device on power supply will be provided in the building installation. The breaking capacity of the device will be adequate to the maximum short circuit current which can flow.
- The safety rules described in this handbook are distinguished by the following symbol and statement:

SAFETY RULES

3.2.2 Labels Indicating Danger, Forbiddance, Command

It is of utmost importance to follow the instructions printed on the labels affixed to the units and assemblies.

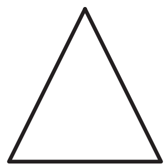
The labels are fully compliant with International Norms ISO 3846–1984. The symbols or statements are enclosed in geometric shapes: ISO 3864–1984.



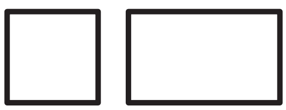
CONTAINS A SYMBOL STATEMENT

INDICATES FORBIDDANCE (WHITE BACKGROUND WHIT RED RIM–BLACK SYMBOL OR STATEMENT)

IT IS A COMMAND (BLUE BACKGROUND–WHITE SYMBOL OR STATEMENT).



CONTAINS A SYMBOL
INDICATES WARNING OR DANGER (YELLOW BACKGROUND–BLACK SYMBOL AND RIM)



CONTAINS A STATEMENT PROVIDING INFORMATION OR INSTRUCTION.

(YELLOW BACKGROUND–BLACK STATEMENT AND RIM)

The labels have been affixed to indicate a dangerous condition. They may contain any standard–known symbol or any statement necessary to safeguard users and service personnel against the most common ones, specifically:

- dangerous electrical voltages
- harmful optical signals
- risk of explosion
- moving mechanical parts
- heat–radiating Mechanical Parts

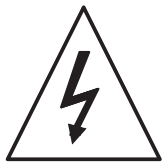
Pay attention to the information stated in the following, and proceed as instructed

The symbols presented in para.3.2.3 through 3.2.7 are all the possible symbols that could be present on Alcatel equipment, but are not all necessarily present on the equipment this handbook refers to.

3.2.3 Dangerous Electrical Voltages

3.2.3.1 Labelling

The following warning label is affixed next to dangerous voltages (>42.4 Vp; >60 Vdc).



If it is a Class 1 equipment connected to mains, then the label associated to it will state that the equipment will have to be grounded before connecting it to the power supply voltage, e.g.:

WARNING !

Ground protect the equipment before connecting it to manins

Make sure that power has been cut off before disconnecting ground protection.

3.2.3.2 Electrical safety: general rules

DANGER! Possibility of personal injury: carefully observe the specific procedures for installation / turn–up and commissioning / maintenance of equipment parts where A.C. or D.C. power is present, described in the relevant installation / turn–up and commissioning / maintenance documents and the following general rules:

a) Personal injury can be caused by –48 V dc (or by 220 V ac if envisaged in the equipment). Avoid touching powered terminals with any exposed part of your body.

b) Short circuiting, low-voltage, low-impedance, dc circuits can cause severe arcing that can result in burns and/or eye damage. Remove rings, watches, and other metal jewelry before working with primary circuits. Exercise caution to avoid shorting power input terminals.

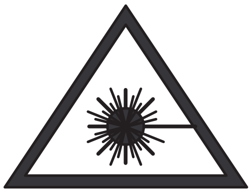
3.2.3.3 Electrical safety: equipment specific data

Refer to para. 5.2.1 on page 213.

3.2.4 Harmful Optical Signals

3.2.4.1 Labelling

If the assembly or unit is fitted with a LASER, the labels must comply with the **IEC 60825–1** and **–2** International Norms.

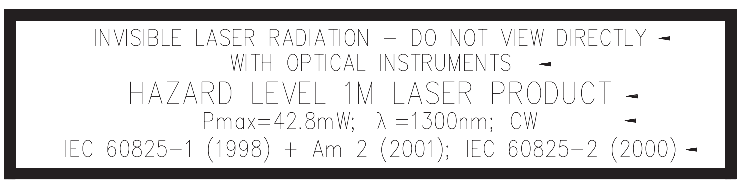


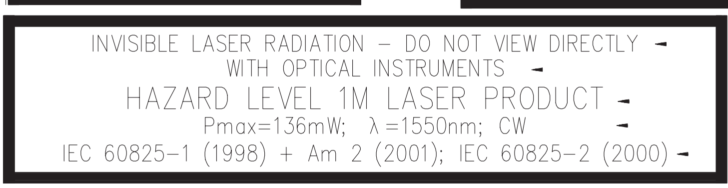
The symbol indicates the presence of a LASER beam. Danger level is stated within a rectangular label:

If the LASER is a Hazard Level 1 or 1M product, the label depicting the symbol within a triangle is not compulsory.

The rectangular shaped label bears all the information needed, i.e.:

- LASER class
- Power emitted
- Wavelength
- Ref. Norm
- Precautionary measures taken depend on LASER class
- Indications given on openings, panels and safety interlocks

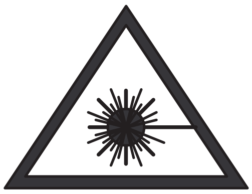




exemple of power and lenght values

3.2.4.2 Optical safety: general rules

On handling optical equipments or units or cables always check that laser labels are properly affixed and that the system complies with applicable optical standards.



DANGER! Possibility of eyes damage: invisible infrared radiations emitted by the fiber optic transmitters can cause eyes damages. Carefully observe the specific procedures for installation / turn–up and commissioning / maintenance of units containing laser devices or cables transporting optical signals, described in the relevant installation / turn–up and commissioning / maintenance documents and the following general rules:

a) Laser radiation is not visible by the naked eye or with laser safety glasses. Although it cannot be seen, laser radiation may be present.

b) Never look directly into a not terminated fiber optic connector or into a broken optical fiber cable, unless it is absolutely known that no laser radiation is present.

c) Never look at an optical fiber splice, cable or connector, unless it is absolutely known that no laser radiation is present.

d) All optical connectors, terminating either fibers and transmitters/receivers, are provided with protective covers that must always be used, as soon as possible, when any optical link is disconnected for installation/test/maintenance purposes or whatever operation.

e) Never look directly into a not terminated fiber optic connector or into a broken optical fiber cable by means of magnifiers/microscopes, unless it is absolutely known that no laser radiation is present. A magnifier/microscope greatly increases the damage hazard to the eyes.

f) Never point a not terminated optical fiber splice, cable or connector to other persons, unless it is absolutely known that no laser radiation is present.

g) Always remove electrical power from near and far optical transmitters before disconnecting optical links between the transmitter and the receiver.

h) Wearing of laser safety goggles or eyes shields is recommended for every person working on optical devices, whenever the above listed rules cannot be followed.

3.2.4.3 Optical safety: equipment specific data

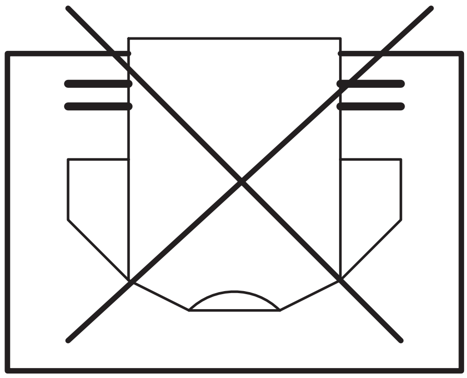
Refer to para. 5.2.2 on page 214.

3.2.5 Risks of Explosions

3.2.5.1 Labelling and safety instructions

This risk is present when batteries are used, and it is signalled by the following label:

Therefore, slits or apertures are made to let air circulate freely and allow dangerous gasses to down flow (battery–emitted hydrogen). A 417–IEC–5641 Norm. compliant label is affixed next to it indicating that the openings must not be covered up.



3.2.6 Moving Mechanical Parts

3.2.6.1 Labelling and safety instructions

The following warning label is affixed next to fans or other moving mechanical parts:

Before carrying out any maintenance operation see that all the moving mechanical parts have been stopped.

3.2.7 Heat–radiating Mechanical Parts

3.2.7.1 Labelling and safety instructions

The presence of heat–radiating mechanical parts is indicated by the following warning label in compliancy with IEC 417 Norm, Fig.5041:

As stated by IEC 60950 Norm., para.1.4.7 the touchable mechanical parts carrying the above depicted warning label, are those whose temperature **T** exceeds the limits established by the following formula (temperatures in °C):

$$(T - T_{amb}) \leq (\Delta T_{max} + 25^{\circ} - T_{mra})$$

where:

T	Temperature of the mechanical part measured at ambient temperature $T_{amb.}$
T_{amb}	Ambient temperature during the test.
ΔT_{max}	Value defined by IEC 950 Norm, Table 16 part 2a, para.5.1, and specified in the table below.
T_{mra}	The maximum room ambient temperature permitted by the equipment specification or 25°C, whichever is greater.

Table 7. IEC 950 –Table 16: Over–temperature limits, Part 2

Operator–accessible parts	**Maximum over–temperature (°C)**		
	Metal	**Glass, porcelain**	**Plastic, rubber**
Handle knob, ect., held or touched for short periods	35	45	60
Handles, knobs, ect., regularly held	30	40	50
Outer surface of the equipment that can be touched	45	55	70
Inner surface of the equipment that can be touched	45	55	70

DANGER! Possibility of personal injury: carefully observe the specific procedures for installation / turn–up and commissioning / maintenance of equipment parts where heat–radiating mechanical parts are present, described in the relevant installation / turn–up and commissioning / maintenance documents and the following general rule:

a) Personal injury can be caused by heat. Avoid touching powered terminals with any exposed part of your body.

3.2.8 Specific safety rules in this handbook

Specific safety rules are specified in the following paragraphs:

– **para. 6.1.1 on page 245**

– **para. 6.5.1.1 on page 247**

– **para. 6.5.2.1 on page 248**

– **para. 6.6.1 on page 249**

4 OTHER NORMS AND LABELS

4.1 Electromagnetic Compatibility

The equipment's EMC norms depend on the type of installation being carried out (cable termination, grounding etc.,) and on the operating conditions (equipment, setting options of the electrical/electronic units, presence of dummy covers, etc.).

- Before starting any installation, turn–on, tests & operation and maintenance work refer to the relevant Handbooks and chapters.
- The norms set down to guarantee EMC compatibility, are distinguished inside this handbook by the symbol and term:

ATTENTION **EMC NORMS**

4.1.1 General Norms – Installation

- All connections (towards the external source of the equipment) made with shielded cables use only cables and connectors suggested in this technical handbook or in the relevant Plant Documentation, or those specified in the Customer's"Installation Norms." (or similar documents)
- Shielded cables must be suitably terminated
- Install filters outside the equipment as required
- Ground connect the equipment utilizing a conductor with proper dia. and impedance
- Mount shields (if utilized), previously positioned during the installation phase, but not before having cleaned and degreased it.
- Before inserting the shielded unit proceed to clean and degrease all peripheral surfaces (contact springs and connection points, etc.)
- Screw fasten the units to the subrack.
- To correctly install EMC compatible equipment follow the instructions given.

4.1.2 General Norms – Turn–on, Tests & Operation

- Preset the electrical units as required to guarantee EMC compatibility
- Check that the equipment is operating with all the shields properly positioned (dummy covers, ESD connector protections, etc.)
- To properly use EMC compatible equipment observe the information given

4.1.3 General Norms – Maintenance

- Before inserting the shielded unit, which will replace the faulty or modified unit, proceed to clean and degrease all peripheral surfaces (contact springs and connection points, etc.)
- Clean the dummy covers of the spare units as well.
- Screw fasten the units to the subrack.

4.2 Electrostatic Dischargers (ESD)

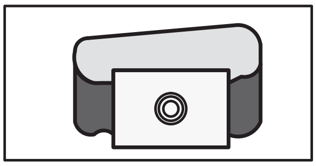
In case of subracks provided with a front cover, follow the precautionary measures below stated, before removing the cover.

Before removing the ESD protections from the monitors, connectors etc., observe the precautionary measures stated. Make sure that the ESD protections have been replaced and after having terminated the maintenance and monitoring operations.

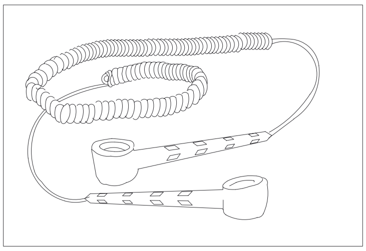
Most electronic devices are sensitive to electrostatic discharges, to this concern the following warning labels have been affixed:

Observe the precautionary measures stated when having to touch the electronic parts and/or the subrack front panel, during the installation/maintenance phases.

Workers are supplied with antistatic protection devices consisting of:



ELASTICIZED BAND



COILED CORD

- an elastic band worn around the wrist
- a coiled cord connected to the elastic band and to the stud on the subrack.

4.3 Suggestions, notes and cautions

Suggestions and special notes are marked by the following symbol:

Suggestion or note....

Cautions to avoid possible equipment damage are marked by the following symbol:

TITLE...

(caution to avoid equipment damage)
statement....

4.4 Labels affixed to the Equipment

This paragraph indicates the **positions** and the **information contained** on the identification and serial labels affixed to the equipment.

Figure 1. to Figure 7. illustrate the most common **positions** of the labels on the units, modules and subracks.

Figure 8. to Figure 11. illustrate the **information** (e.g., identification and serial No.) printed on the labels.

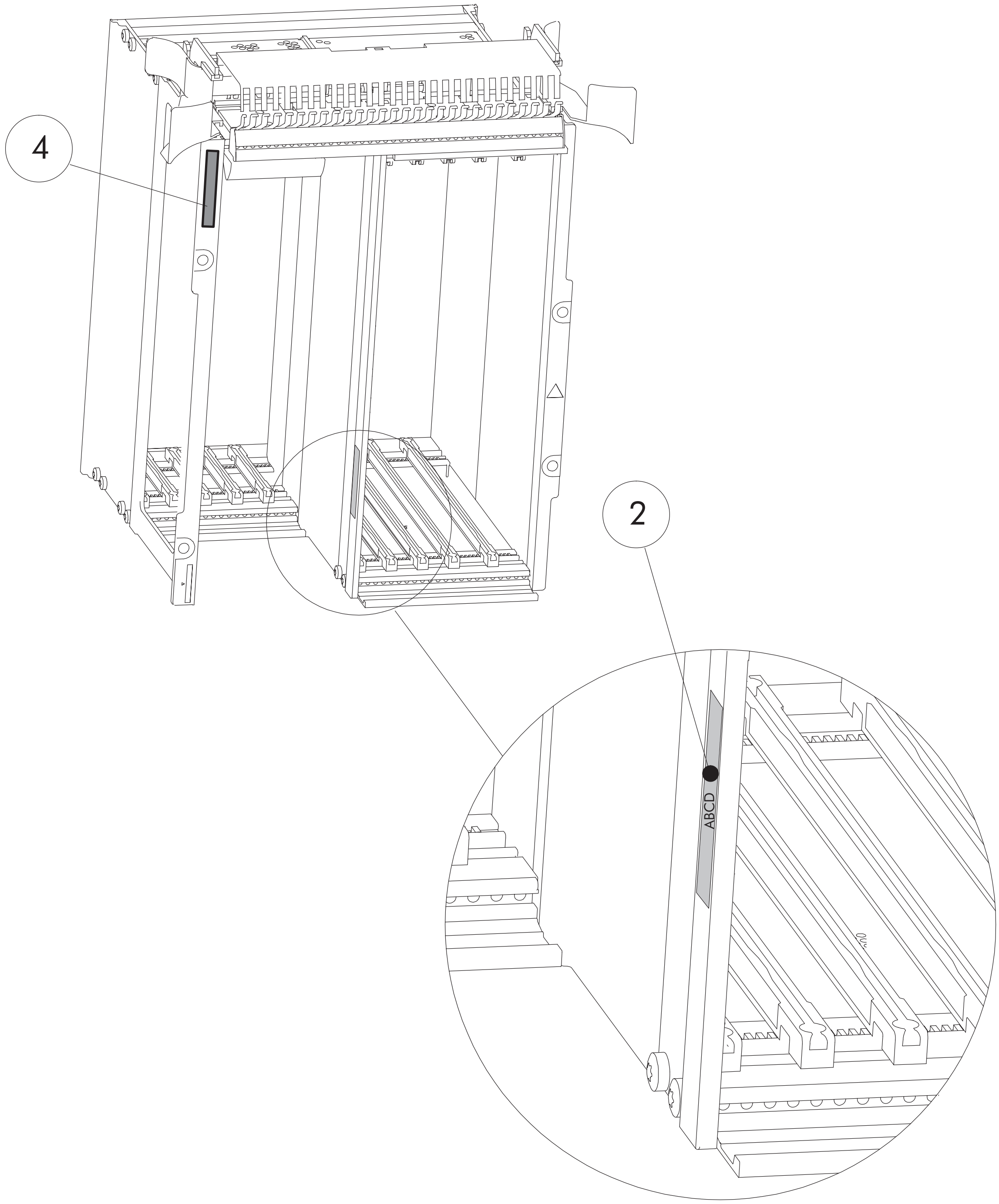
The table below relates the reference numbers stated on the figures to the labels used.

Labelling depicted hereafter is for indicative purposes and could be changed without any notice.

Table 8. Label references

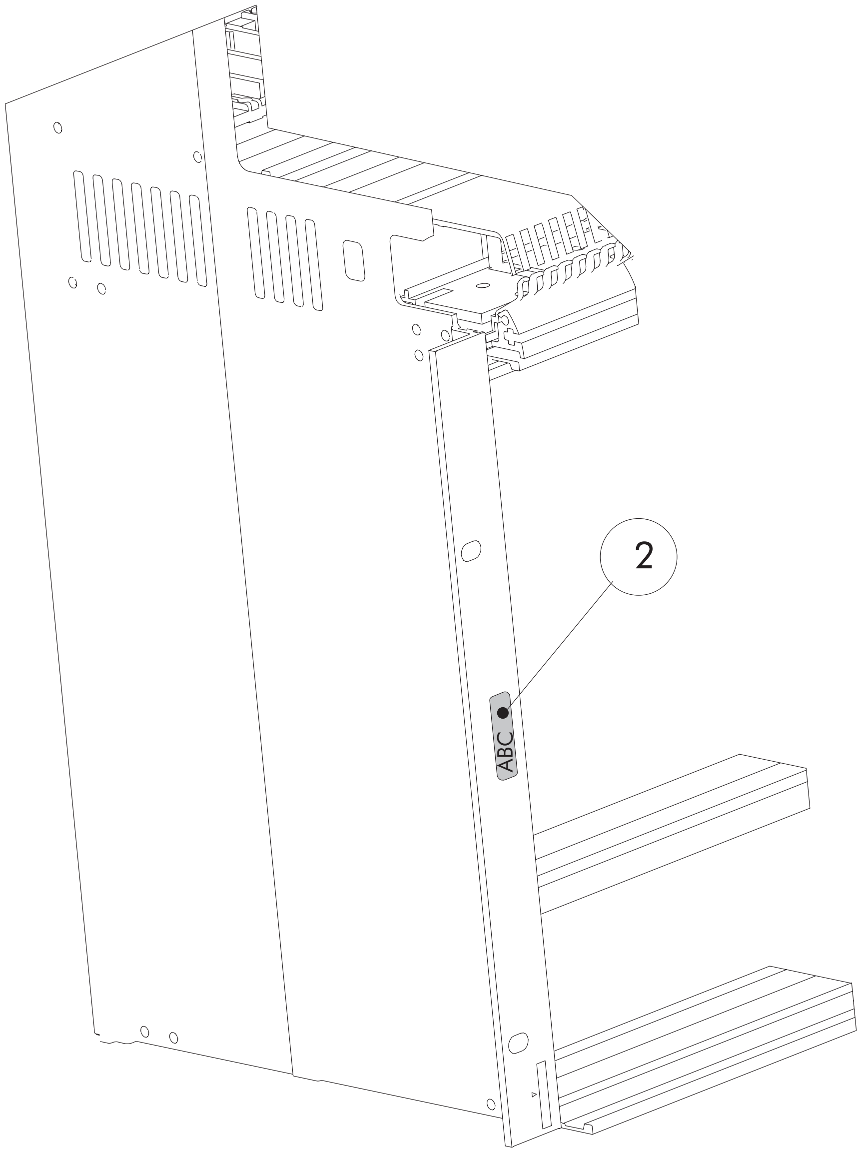
Ref. No.	Name of Label
1	label specifying item not on catalogue (P/N. and serial number)
2	label specifying item on catalogue (P/N. and serial number)
3	item identification label – item on catalog
4	label identifying the equipment

On contract basis, customized labels can be affixed to the equipment.
Standard labels can be affixed to any position on the equipment, as required by the Customer.
However, for each of the above are applied the rules defined by each individual Customer.



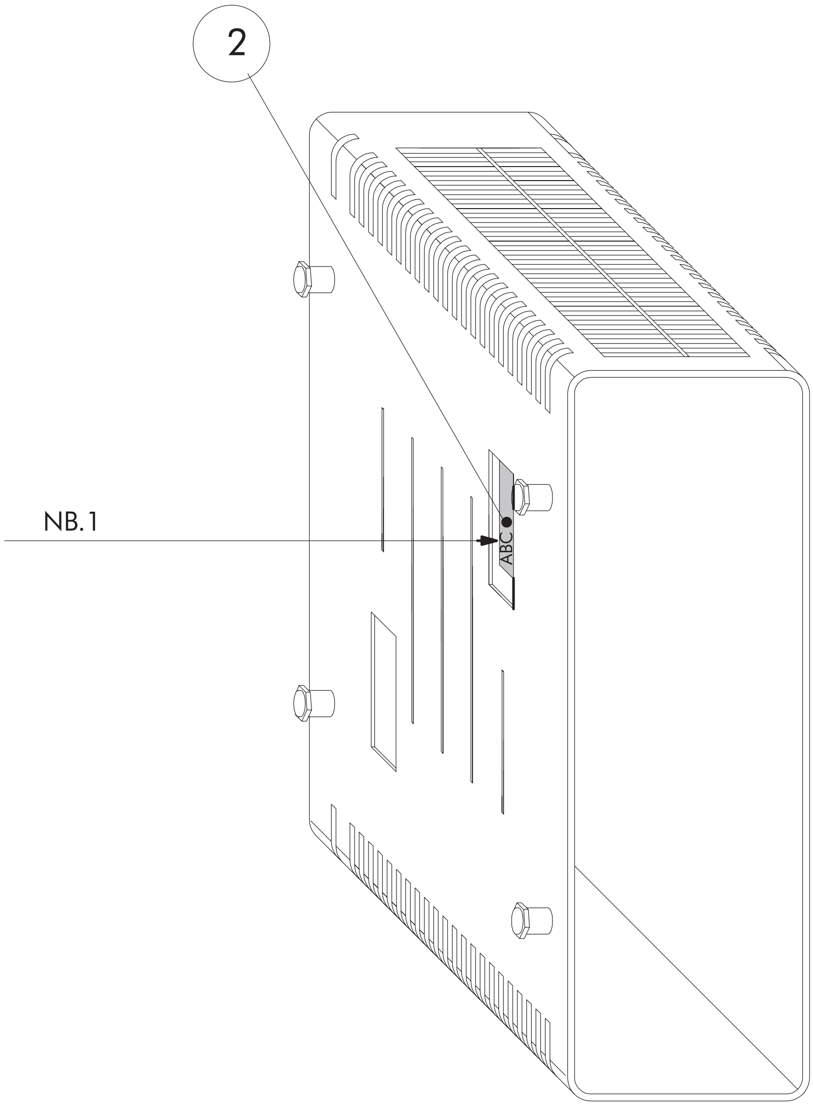
NOTE : The above reference numbers are detailed on Table 8. on page 32

Figure 1. Subrack label



NOTE : The above reference numbers are detailed on Table 8. on page 32

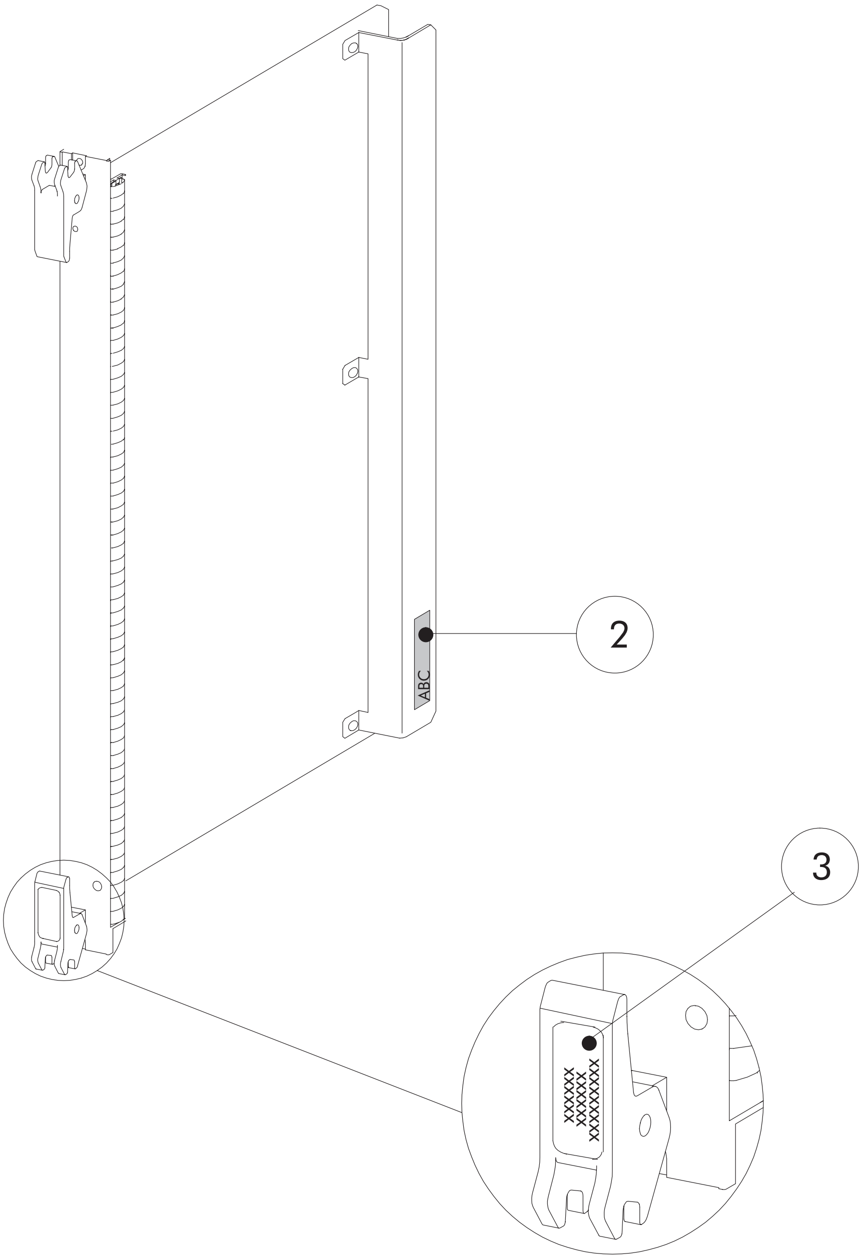
Figure 2. Subrack label



NB.1 = The label is present on the support side

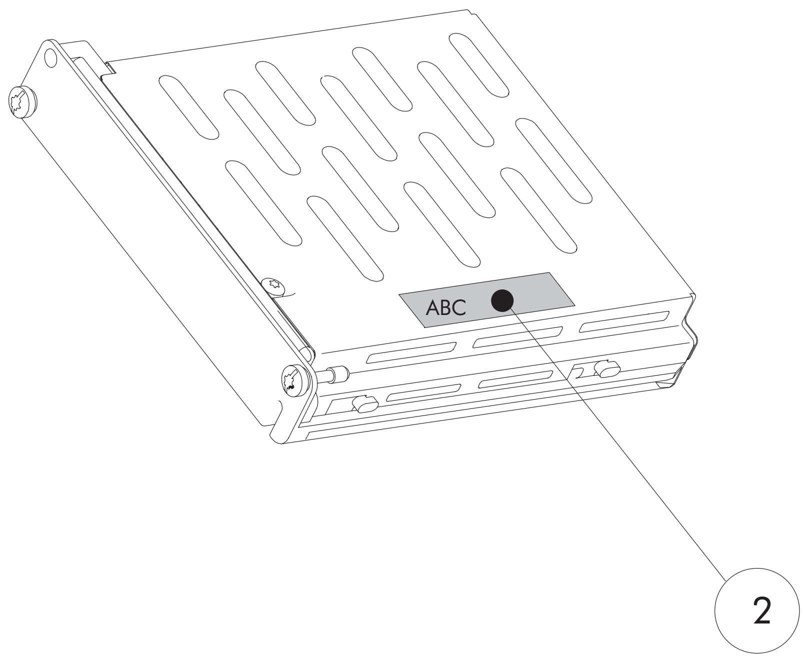
NOTE : The above reference numbers are detailed on Table 8. on page 32

Figure 3. Subrack label



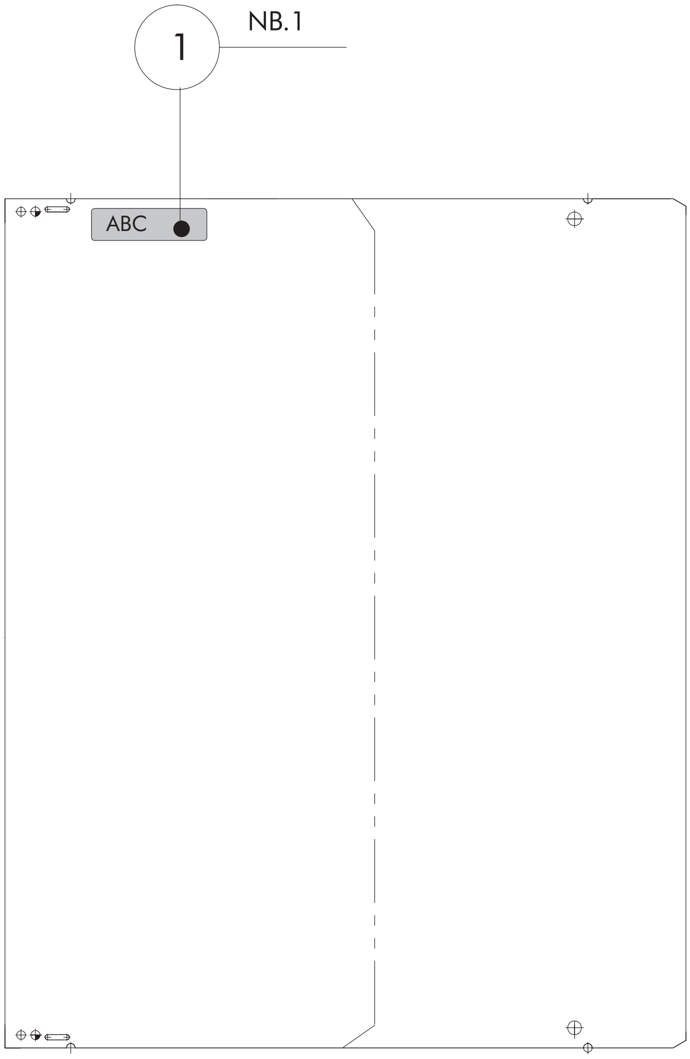
NOTE : The above reference numbers are detailed on Table 8. on page 32

Figure 4. Labels on units with standard cover plate



NOTE : The above reference numbers are detailed on Table 8. on page 32

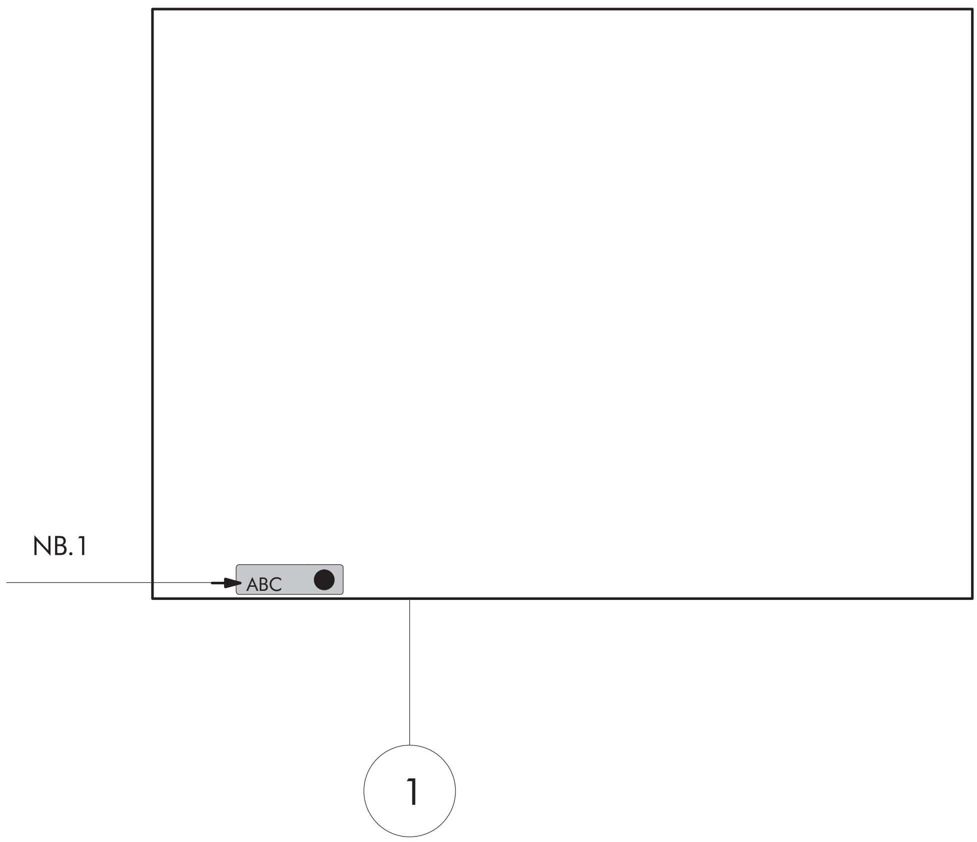
Figure 5. Modules label



NB.1 = The label is present on the p.c.s. component side

NOTE : The above reference numbers are detailed on Table 8. on page 32

Figure 6. Internal label for Printed Board Assembly



NB. 1 = The label is present on p.c.s. components side or rear side on the empty spaces.

NOTE : The above reference numbers are detailed on Table 8. on page 32

Figure 7. Back panels internal label

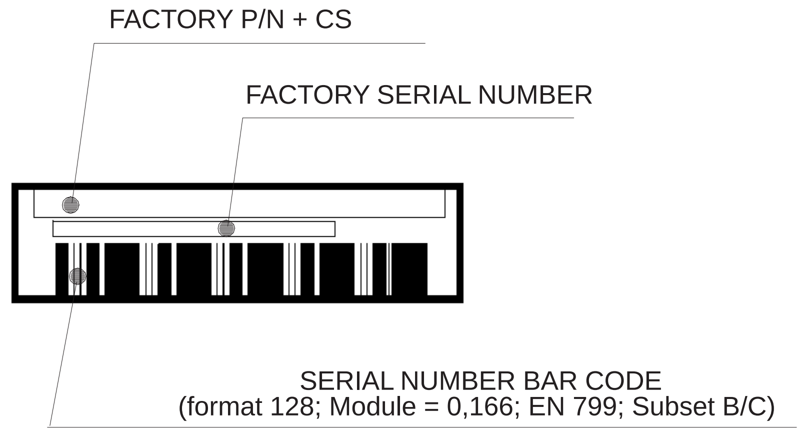


Figure 8. Label specifying item not on catalogue (P/N. and serial number)

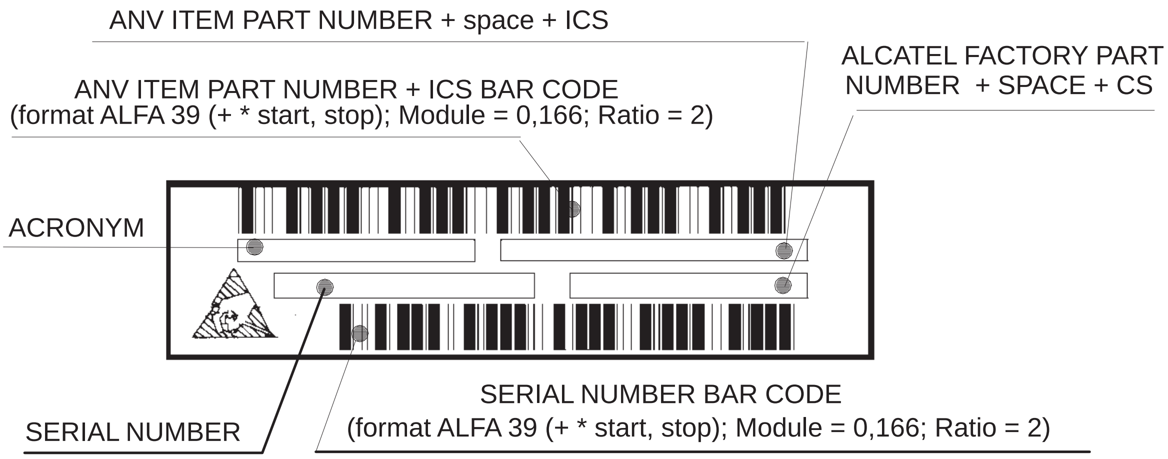


Figure 9. Label specifying item on catalogue (P/N. and serial number)

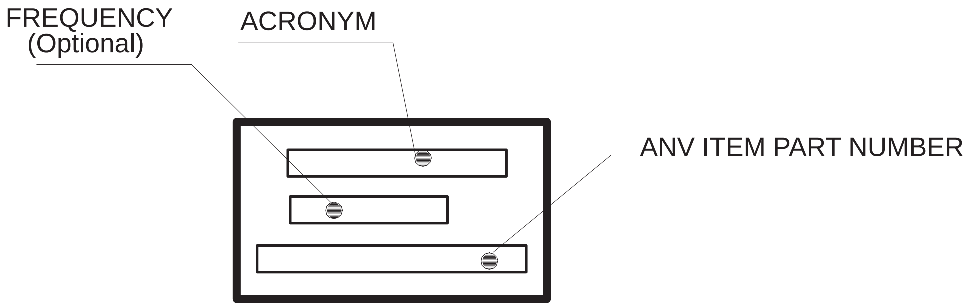


Figure 10. Item identification labels – item on catalog

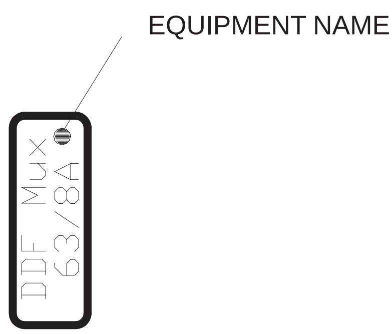


Figure 11. Label identifying the equipment (example)

5 LIST OF ABBREVIATIONS

ACO	Alarm Cut Off
A/D	Add and Drop functionality
ADM	Add and Drop Multiplex
AFI	Authority and Format Identifier
AIS	Alarm Indication Signal
ALS	Automatic Laser Shutdown
AMS	proprietary Alcatel Maintenance Signal; there are two types of AMS: AMSs (for legacy submarine equipment) and AMSt (for legacy terrestrial equipment)
APS	Automatic Protection switching
APSD	Automatic Power ShutDown
AS	Alarm Surveillance
ASAP	Alarm Severity Assignment Profile
ASIC	Application Specific Integrated Circuit
ATTD	ATTendeD (Alarm storing)
BER	Bit Error Rate
BOL	Beginning of Life
CBR	Constant Bit Rate
CD–ROM	Compact Disk Read Only Memory
Ch	Channel
CID	Card IDentifier
CLEI	Common Language Equipment Identification
Client–AIS	proprietary Alcatel Maintenance Signal, defined as a G709 frame with all–ones in the OPU–Payload and 0x8F code in the OPU payload–type
CLNP	Connection Less Network Protocol
CPE	Costumer Premises Equipment
CT	Craft Terminal
DAPI	Destination Access Point Identifier
DC_DC	DC/DC Converter
DCC	Data Communication Channel
DCN	Data Communication network

DCU	Dispersion Compensating Unit
DL	Download
DMUX	Demultiplexing
DTMF	Dual Tone Modulation FrequencyDTV (Decision Threshold voltage)
DTV	Decision Threshold voltage
DV	Digital Video
DWDM	Dense Wavelength Division Multiplex
EC	Equipment Controller
ECID	Enhanced Card IDentifier
ECT	Equipment Craft Terminal
ECC	Embedded Channel Communication
ECID	Extended Card IDentity
EDFA	Erbium Doped Fiber Amplifier
EEPROM	Electrically Erasable Programmable Read Only Memory
EMC	Electromagnetic compatibility
EMI	Electromagnetic Interference
EML	Equipment Management Layer
EOL	End Of Life
EOW	Engineering Order Wire
EPLD	Erasable Programmable Logical Device
ESC	Equipment and Shelf Controller
ESD	Electrostatic Discharges
ETSI	European Telecommunication Standard Institute
EXP	Expansion
FC	Fiber Channel
FDI	Forward Defect Indication
FIT	Failure In Time
FPGA	Field Programmable Gate Array
GCC	Generic Communication Channel
GNE	Gateway Network Element

HDLC	High Level Data Link Control
HK	House Keeping
HW	HardWare
HWF	HardWare Failure
IEC	International Electrotechnical Commission
I/F	Interface
ILM	Integrated Laser Modulator
ILOS	Input Loss Of Signal
IND	INDeterminate
I/O	Input/Output
IP	Internet Protocol
IS–IS	Intermediate System–to–Intermediate System
ISO	International Standard Organization
ISPB	Intra Shelf Parallel Bus
ISSB	Intra Shelf Serial Bus
ITU_T	International Telecommunication Union –Telecommunication
LAN	Local Area Network
LAPD	Link Access Protocol D
LB	Long Band
LOF	Loss Of Frame
LOS	Loss Of Signal
LED	Light Emitting Diode
LM	Light Manager
LR	Line Repeater
LSD	Laser ShutDown
LT	Line Terminal
MAC	Medium Access Control
MMF	Multi Mode Fiber
MS	Multiplex Section
MZ	Mach–Zehnder

NE	Network Element
NDC	Negative Dispersion Chromatic
NES	Network Element Synthesis
NML	Network Management Layer
NMS	Network Management System
NNI	Node Network Interface
NSAP	Network Service Access Point
NTP	Network Time Protocol
NURG	Not URGent
OAC	Optical Amplifier Card
OADM	Optical Add and Drop Multiplexer
OBC	On Board Controller
OCH	Optical Channel
OH	OverHead
OCHA	Optical Channel Adaptation
ODU	Optical channel Data Unit
OGPI	Optical Generic Physical Interface
OMS	Optical Multiplex Section
OMSA	Optical Multiplex Section Adaptation
OS	Operation System
OSC	Optical Supervisory Channel
OSMC	Optical Spectrum Monitoring Control
OSNR	Optical Signal Noise Ratio
OSPI	Optical Generic Physical Interface
OTN	Optical Transport Network
OTS	Optical Transmission Section
OTU	Optical channel Transport Unit
PDH	Plesiochronous Digital Hierarchy
PDU	Power Distribution Unit
PIN	Positive – Intrinseque – Negative (photodiode technology)

PM	Performance Monitoring
Q3	Interface with Q3 Protocol
QECC	Interface with Q protocol for Embedded Control Channel
QoS	Quality of Service
RAM	Random Access Memory
RA	Remote Alarm
RDI	Remote Defect Indication
RECT	REmote Craft Terminal
RI	Remote Inventory
RIN	Relative Intensity Noise
RPO	Receiver Parameter Optimisation
RS	Regenerator Section
RS–AIS	proprietary Alcatel Maintenance Signal, defined as a SDH RS frame, with all ones except Frame Alignment Word and B1 parity
RSOH	Regenerator Section Overhead
SAPI	Source Adress Point Identifier
SBS	Stimulated Brillouin Scattering
SH	System Handler
SLTE	Submarine Line Terminal Equipment
RUM	Replaceable Unit Missing
RUP	Replaceable Unit Problem
RUTM	Replaceable Unit Type Mismatch
RX	Receiver
SB	Short Band
SC	Shelf Controller
SCP	Serial Communication Problem
SD	ShutDown
SDH	Synchronous Digital Hierarchy
SMSR	Side Mode Suppression Ratio
SFF	Small Form Factor
SFP	Small Form Factor Pluggable

SMF	Single Mode Fiber
SNCP	Sub–Network Connection Protection
SPI	Serial Peripheral Interface
SSF	Server Signal Failure
SW	SoftWare
SWDL	SoftWare DownLoad
SWP	SoftWare Product
TCA	Threshold Crossed Alarm
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM	Time Division Multiplexing
TIM	Trace Identifier Mismatch
TimActDis	TIM consequent actions disabled
TMN	Telecommunication Management Network
TP	Termination Point
TRU	Top Rack Unit
TTP	Trail Termination Point
TX	Transmitter
UDC	User Data Channel
UEP	Unequipped Equipment Present
UIC	User Interface Card
UNI	User Node Interface
UR	Unrepeatered Systems
URG	URGent
USM	User Service Manager
VHM	Virtual Hardware Machine
VOA	Variable Optical Attenuator
VSR	Very Short Reach
WDM	Wavelength Division Multiplexing

6 GENERAL ON ALCATEL CUSTOMER DOCUMENTATION

6.1 Products, product-releases, versions and Customer Documentation

A **”product”** is defined by the network hierarchical level where it can be inserted and by the whole of performance and services for which it is meant.
A ”product” evolves through successive **”product-releases”** which are the real products marketed for their delivery at a certain ”product-release” availability date.

So, a ”product–release” defines a set of hardware components and a software package which, as a whole, identify the possible network applications and the equipment performance which the specific ”product-release” has been designed, engineered and marketed for.

In some cases a ”product-release” has further development steps, named **”versions”**, that are born to improve or add some performance (mainly software) with respect to the previous version, or for bug fixing purposes.

A ”product-release” has its own standard Customer Documentation, composed by one or more handbooks.

A new ”version” of a ”product-release” may or may not produce a change in the status of the Customer Documentation set, as described in para.6.4 on page 50.

6.2 Handbook supplied to Customers

Handbooks are not automatically delivered together with the equipment they refer to.
The number of handbooks per type to be supplied must be decided at contract level.

6.3 Aims of standard Customer Documentation

Standard Customer Documentation, referred to hereafter, must be always meant as plant-independent. Plant-dependent documentation, if envisaged by the contract, is subjected to commercial criteria as far as contents, formats and supply conditions are concerned (plant-dependent documentation is not described here).

Standard hardware and software documentation is meant to give the Customer personnel the possibility and the information necessary for installing, commissioning, operating and maintaining the equipment according to Alcatel Laboratory design choices.
In particular: the contents of the handbooks associated to the software applications focus on the explanation of the man-machine interface and of the operating procedures allowed by it; maintenance is described down to faulty PCB location and replacement.

Consequently, no supply to the Customers of design documentation (like PCB hardware design and production documents and files, software source programs, programming tools, etc.) is envisaged.

The handbooks concerning hardware (usually the ”Technical Handbook”) and software (usually the ”Operator’s Handbook”) are kept separate in that any product changes do not necessarily concern their contents.

For example, only the Technical Handbook might be revised because of hardware configuration changes (e.g., replacing a unit with one having different P/N but the same function).
On the other hand, the Operator’s Handbook is updated because of a new software version but which does not concern the Technical Handbook as long as it does not imply hardware modifications.
However, both types of handbooks can be updated to improve contents, correct mistakes, etc..

6.4 Handbook Updating

The handbooks associated to the ”product–release” are listed in para. 1.3 on page 12.

Each handbook is identified by:
– the name of the ”product-release” (and ”version” when the handbook is applicable to the versions starting from it, but not to the previous ones),
– the handbook name,
– the handbook P/N,
– the handbook edition (usually first edition=01),
– the handbook issue date. The date on the handbook does not refer to the date of print but to the date on which the handbook source file has been completed and released for the production.

6.4.1 Changes introduced in the same product-release (same handbook P/N)

The edition and date of issue might change on future handbook versions for the following reasons:

– only the date changes (pointed out in the Table of Contents) when modifications are made to the editorial system not changing the technical contents of the handbook.

– the edition, hence the date, is changed because modifications made concern technical contents. In this case:

  - the chapters modified with respect to the previous edition are listed in Table 6. on page 16;
  - in affected chapters, revision bars on the left of the page indicate modifications in text and drawings.

Changes concerning the technical contents of the handbook cause the edition number increase (e.g. from Ed.01 to Ed.02). Slight changes (e.g. for corrections) maintain the same edition but with the addition of a version character (e.g. from Ed.02 to Ed.02A). Version character can be used for draft or proposal editions.

NOTES FOR HANDBOOKS RELEVANT TO SOFTWARE APPLICATIONS

Handbooks relevant to software applications (typically the Operator’s Handbooks) are not modified unless the new software ”version” distributed to Customers implies man–machine interface changes or in case of slight modifications not affecting the understanding of the explained procedures.

Moreover, should the screen prints included in the handbook contain the product-release’s ”version” marking, they are not replaced in the handbooks related to a subsequent version, if the screen contents are unchanged.

6.4.1.1 Supplying updated handbooks to Customers

Supplying updated handbooks to Customers who have already received previous issues is submitted to commercial criteria.
By updated handbook delivery it is meant the supply of a complete copy of the handbook new issue (supplying errata–corrige sheets is not envisaged).

6.4.2 Changes due to a new product-release

A new product-release changes the handbook P/N and the edition starts from 01.
In this case the modified parts of the handbook are **not** listed.

6.5 Customer documentation supplied on CD–ROM

In the following 'CD–ROM' means 'Customer Documentation on CD–ROM'.

6.5.1 Contents, creation and production of a CD–ROM

In most cases, a CD–ROM contains in read–only electronic format the documentation of one product–release(–version) and for a certain language.
In some other cases, the same CD–ROM can contain the documentation of different product–release(–version)s for a certain language.

As a general rule:

– CD–ROMs for Network Management products do not contain:
  - the Installation Guides
  - the documentation of system optional features that Customers could not buy from Alcatel together with the main applicative SW.
– CD–ROMs for Network Elements products do not contain:
  - the documentation of system optional features (e.g. System Installation Handbooks related to racks that Customers could not buy from Alcatel together with the main equipment).

A CD–ROM is obtained collecting various handbooks and documents in **.pdf** format. Bookmarks and hyperlinks make the navigation easier. No additional information is added to each handbook, so that the documentation present in the CD–ROMs is exactly the same the Customer would receive on paper.

The files processed in this way are added to files/images for managing purpose and a master CD–ROM is recorded.

Suitable checks are made in order to have a virus–free product.

After a complete functional check, the CD–ROM image is electronically transferred to the archive of the Production Department, so that the CD–ROM can be produced and delivered to Customers.

6.5.2 Use of the CD–ROM

The CD–ROM can be used both in PC and Unix WS environments.

The CD–ROM starts automatically with autorun and hyperlinks from the opened “Index” document permit to visualize the **.pdf** handbooks.
Other hyperlinks permit to get, from the Technical handbooks, the specific .pdf setting documents.

In order to open the **.pdf** documents Adobe Acrobat Reader Version 4.0 (minimum) must have been installed on the platform.
The CD–ROM doesn’t contain the Adobe Acrobat Reader program. The Customer is in charge of getting and installing it.
ReadMe info is present on the CD–ROM to this purpose.

Then the Customer is allowed to read the handbooks on the PC/WS screen, using the navigation and zooming tools included in the tool, and to print selected parts of the documentation through a local printer.

6.5.3 CD–ROM identification

Each CD–ROM is identified:

1) by the following external identifiers, that are printed both on the booklet and the CD–ROM upper surface:
- the name of the ”product–release(s)” (and ”version” if applicable),
- a writing indicating the language(s),
- the CD–ROM P/N (Factory P/N and ANV P/N),
- the CD–ROM edition (usually first edition=01)

2) and, internally, by the list of the source handbooks and documents (P/Ns and editions) by whose collection and processing the CD–ROM itself has been created.

6.5.4 CD–ROM updating

The list of source handbook/document P/Ns–editions indicated in previous para. **6.5.3** point **2)**, in association with the CD–ROM own P/N–edition, is also loaded in the Alcatel–Information–System as a structured list.
Whenever a new edition of any of such handbooks/documents is released, a check is made in the Alcatel–Information–System to identify the list of CD–ROMs that must be updated to include the new editions of these handbooks/documents.
This causes the planning and creation of a new edition of the CD–ROM.
Updating of CD–ROMs always follows, with a certain delay, the updating of the single handbooks composing the collection.

DESCRIPTIONS

1 GENERAL

1.1 Introduction to the equipment

The Alcatel 1626 Light Manager (1626 LM in the following) is the new platform of Dense Wavelength Division Multiplexing (DWDM) systems for Core Networks.
The Alcatel 1626 LM addresses terrestrial applications from Long–Haul (< 600 km) to Ultra Long–Haul (up to 4500 km) and unrepeatered submarine applications (400 Km single span), from average capacity for regional networks up to large capacity for pan–continental networks (up to 192 wavelengths).

One main strength of the Alcatel 1626 LM is its ability **to upgrade legacy platforms without traffic interruption**. Carriers can keep their installed DWDM base and increase its capacity by loading new wavelengths from the 1626 LM. This provides to carriers a state–of–art technology and advanced features without wasting the investment previously granted.

It is compliant with both ETSI and NEBS standards.

System capacity

The Alcatel 1626 LM provides a high transmission capacity on a single optical fiber by multiplexing up to:

- 80 x 10 Gbps (STM–48/OC–192) channels on a 50 GHz grid in C–band (1530nm to 1562nm) in Rel.1.X
- 96 x 10 Gbps (STM–48/OC–192) channels on a 50 GHz grid in the extended C–band (1530nm to 1568.6nm) in Rel.2.0

Furthermore, the architecture is compatible with the future introduction of 40Gbps signal.

Rel. 2.0 supports Rel. 1.x configurations, for example for adding TRBD1121.

System structure

It is based on transponders, mux/demux and optical amplifiers. The transponders are connected to optical Mux/Demux which manages the main DWDM signal (combined signal) and launch it in the fibre by means of optical amplifiers.

The following types of 3R **transponders**, G.709 compliant, are foreseen:
– LH/VLH/ULH Tributary Direct 10Gb/s Transponder, respectively optimized for Long/Very Long/Ultra Long Haul applications
– Tributary Concentrator 4x2.5Gb/s Transponder, optimized for Very Long Haul applications

According to G.709 Rec, both UNI signals at 2.488/9.95Gbps (in current rel.) and NNI signals at 2.666/10.709 Gbps (in future rel.) are supported, client side.

The NE has a Modular **Mux/Demux** architecture based on sub–bands of 8 channels (50GHz spaced) supporting system scalability, Band–OADM and (in future release) Per–Band Dispersion Compensation.
In B&W to WDM (ingress) direction, a Channel Mux/Demux, multiplexes 8 channels @50GHz into one band, feeding a Band Mux/Demux, which multiplexes up to 10 bands into the aggregate signal (up to 12 bands/96 channels in Rel.2.0). The reverse operation is performed in egress (WDM to B&W) direction.

Line Optical Fibers Amplifiers, are introduced in current release. They are dual–stage Erbium Doped Fiber Amplifier (EDFA), designed to amplify the aggregate/line signal, in the extended C–band.
Band Optical Fiber Amplifiers, designed to amplify one band (8–ch), will be provided in future release.

Other main features

- **G.709/G.798 Optical Layer Management**
  - Future proof platform moving from pre–OTN system to OTN thanks to the G.709, 10 Gbps transponders and concentrators
  - Gradual G.709 feature support through simple SW upgrades
  - Same Transponder HW delivering both UNI and NNI B&W interfaces toward the client side (NNI software management will be provided in future rel.)
  - Colored NNI interfaces: OTU–2 (10.709 Gbps)
  - Enhanced FEC algorithm on colored interface to boost span reach
  - Client side PM based on B1 (and J0 n.i.m. TBC) and threshold crossing alarm based on B1 errors count (Sonet+SDH)
  - PM and TCA at transmission section level based on FEC corrected/uncorrected errors
  - Client independent performance monitoring functionalities, by means of 4 x 2.5 Gbps concentrator (TRBC1111)
  - Full transparent concentration functionality from 2.5Gbps to 10 Gbps
  - G.709 maintenance signal (GEN_AIS)
  - G709 Generic Communication Channels providing 2Mbps clear channel per 10 Gbps transmitted channel. G709 GCC are managed inside the WDM line only. This feature will be available in maintenance release (R2.0a) on TRBD only.

- **In–service upgrade of already installed DWDM links** by means of 1626 LM transponders only or both transponders and mux/demux, providing the evolution path both for terrestrial 1686 WM/1640 WM and Unrepeatered Alcatel WDM links. For details, refer to 3AL 94720 AAAA (REL.1.0), 3AL 94799 AAAA, (rel.1.2) technical handbooks

- **Upgrade of rel. 1.x systems installation**

- **From Rel.2.0, it is a stand–alone system: pure 1626 LM links can be installed**

- **Multiple configurations and multiple network architectures**
  The 1626 LM can be configured as
  - line terminal (LT)
  - line repeater (LR)
  - Optical Add and Drop Multiplexer (OADM) repeater (OR)
  - Back–to–back terminal (BTB).

  These basic configurations address all the different optical network applications. It covers both point–to–point and point–to–multipoint applications in mesh contexts as well as in ring scenarios.

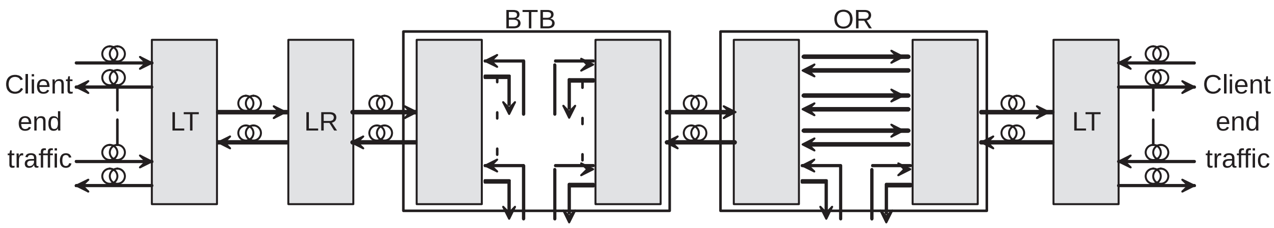


Figure 12. Example of 1626 LM configurations in a WDM line

- **Flexible and scalable architecture**
  The 1626 LM design allows to begin with a partially equipped configuration (e.g.: 8 channels) that can be progressively upgraded as the traffic demand grows, with a 8 channels mux/demux granularity (e.g.: 16, 24, 32 ... 96 channels in Rel.2.0). In particular, from the initial configuration, the transmission capacity can be increased without interrupting the existing traffic.

– **Up to 16 x 10Gbps optical channels in a single shelf; up to 48 x 10Gbps optical channels in a single rack. Up to two racks are managed**
Each client signal is assigned to one of the optical channels provided by the transponders. Each channel is associated to a fixed wavelength chosen in 3rd window or extended C–band (1.550 nm) thus handling 96 channels @50GHz

– **host SFP interfaces (STM–16)** are supported

– **Traffic Flexibility.** The NE provides the add/drop capability by means of
- Band_OADM (a modified Band–Mux/Demux) providing the capability to add/drop
  - up to 100% of the traffic in asymmetric configuration (single side)
  - up to 60% of the traffic in symmetric configuration (double side)

  supporting up to 7 wavelengths @ 50 GHz per band. Future upgrade to 13 wavelenghts exploiting the 25 GHz grid, is planned. All the bands that are not extracted are in complete pass–through, without any regeneration
- Channel_OADM providing the capability to add/drop up to 100% of the traffic, with single wavelength granularity and re–configurable SW (future release)

– **Protection.** The following protection types will be provided (in future releases)
- 1:1 OMS protection, devoted to the protection of both the cable cuts and Line amplifier failures
- 1+1 bidirectional Lambda protection
- 1:N bidirectional Lambda protection

– **Supervision**
In order to supervise all the NEs along a WDM path an optional Optical Supervisory Channel (OSC) @ 4864 Mbps (2Mbps OSC + 2Mbps UDC), is inserted in a 1510nm out–of–band wavelength and added to the aggregate signal. UDC will be provided in future release

– **Automatic laser control**
This feature facilitates the loading of the system with a few number of modulated channels or to compensate for the loss of some modulated channels

– **Management Interfaces**
The 1626 LM is managed by the Alcatel NM system, providing a single management solution including OMSNs and XC. Q3 interface is supported.
In ETSI market the NE is managed by the Alcatel 1353NM and 1354RM by means of the Q3 interface. In the upgrade scheme, the 1626 LM is managed as a separate NE

– **User Interfaces** for various overhead for data channels and orders wires using are provided (future release):
- up to 4 x 64 kbit/s (F1 or NU or E1 or E2 bytes)
- up to 2 x E1 (2Mbps) or T1 (1.5Mbps)
- up to 2 x RS232 (carrying signals up to 19.2 Kbps for inter NEs exchanges)
- an audio interface (phone)

– **CPE** : two types of CPE will be provided (in future release)
- a 8–channels capacity (multiplexed by CMDX) equipment able to perform a first traffic aggregation step in sites far from the system terminals
- a N single wavelenghts not multiplexed capacity, in a remotized shelf

– **Firmware download**
In–service upgrade providing an automatic firmware update of the slave boards after each software update.

1.2 Rel. 2.0 equipment basic configurations

The 1626 LM rel. 2.0 design, allows the following basic configurations of the equipment:

- line terminal (LT)
- line repeater (LR)
- Optical Add and Drop Multiplexer (OADM) repeater (OR)
- Back–to–back terminal (BTB).

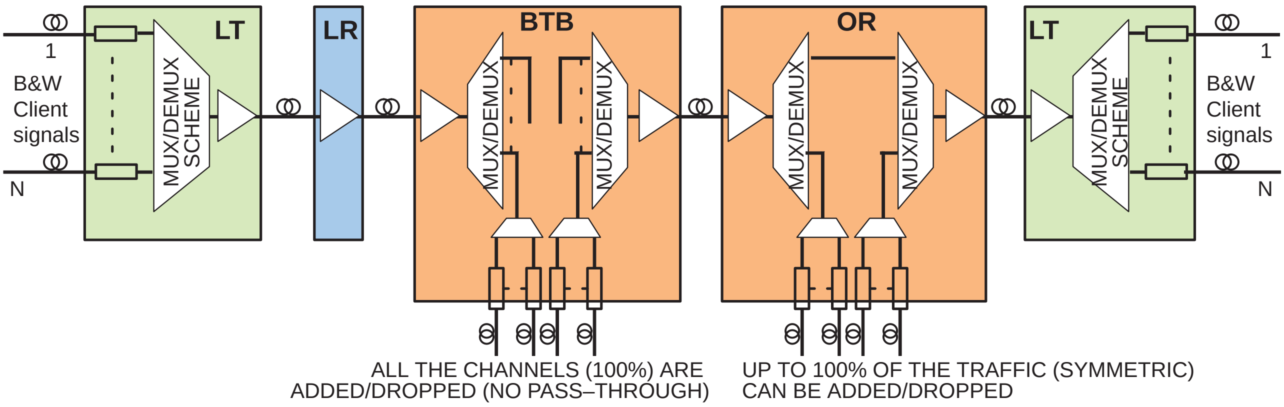


Figure 13. Example of WDM line

From rel. 2.0 the 1626 LM is a stand–alone NE, hence all the boards are 1626 LM ones.

Rel. 2.0 supports Rel. 1.x configurations, for example for adding TRBD1121.

In the following paragraphs/figures

- CMDX stands for Channel Mux/Demux (8:1/1:8 mux/demux)
- BMDX stands for Band Mux/Demux (BMDX1000) in line terminal and back–to–back terminal configuration or Band OADM (BMDX1100) in OADM configuration
  - the BMDX1000 supports up to 8 wavelengths per band but not does not allow the band pass–thru (in back–to–back configuration) functionality
  - the BMDX1100 supports up to 7 wavelengths per band and allows the full transparent pass–thru at band level
- LOFA stands for Line Optical Fiber Amplifier, designed to amplify the aggregate signal (all the extended C–band)
- OSCU stands for Optical Supervisory Channel Unit, allowing the NE management: OSC is extracted (inside LOFA) from the aggregate signal before entering the pre–amplifier and then added after the optical amplification of the aggregate signal, allowing to remotely manage the NE also in case of optical amplifier failure. The added/dropped signal is coming from/sent to OSCU communicating with ESCT.

In the next block schemes, only Tributary Direct Transponders (TRBD) with one 10 Gbps B&W client signal and one coloured 10 Gbps signal, are taken into account.
The Tributary Concentrator (TRBC) with 4 x 2.5Gbps B&W client signals and one coloured 10Gbps signal is not shown in the following figures, for semplicity reason.

In the following are detailed the various configurations.

1.2.1 Line Terminal (LT)

In Line Terminal configuration (LT), the 1626 LM connects, according to the system architecture,

- up to 96 x 10Gbps B&W client signals, with TRBD using, or
- 384 x 2.5Gbps B&W client signals, with TRBC using

to an optical fibre DWDM line. Mixed configuration are allowed.
In every case, up to 96 colored WDM signals are multiplexed in the line/aggregate signal.
The LT is placed at both ends of point–to–point links.
Up to 96 channels/wavelengths (12 bands) are managed in current release.
It is made up of

- line amplifiers (LOFA), with the extraction/insertion of the OSC before/after the double–stage amplifier
- up to 12 CMDX and 1 BMDX1000 providing the 1626 LM mux/demux scheme
- transponders (TRBC and/or TRBD).
- ALCT allowing system loading and (optional) OSCU providing NE(s) supervision

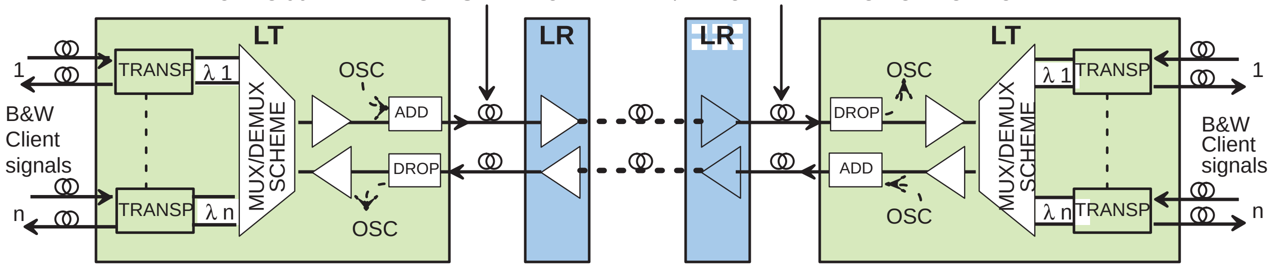


Figure 14. Generic example of LT configuration in point–to–point application

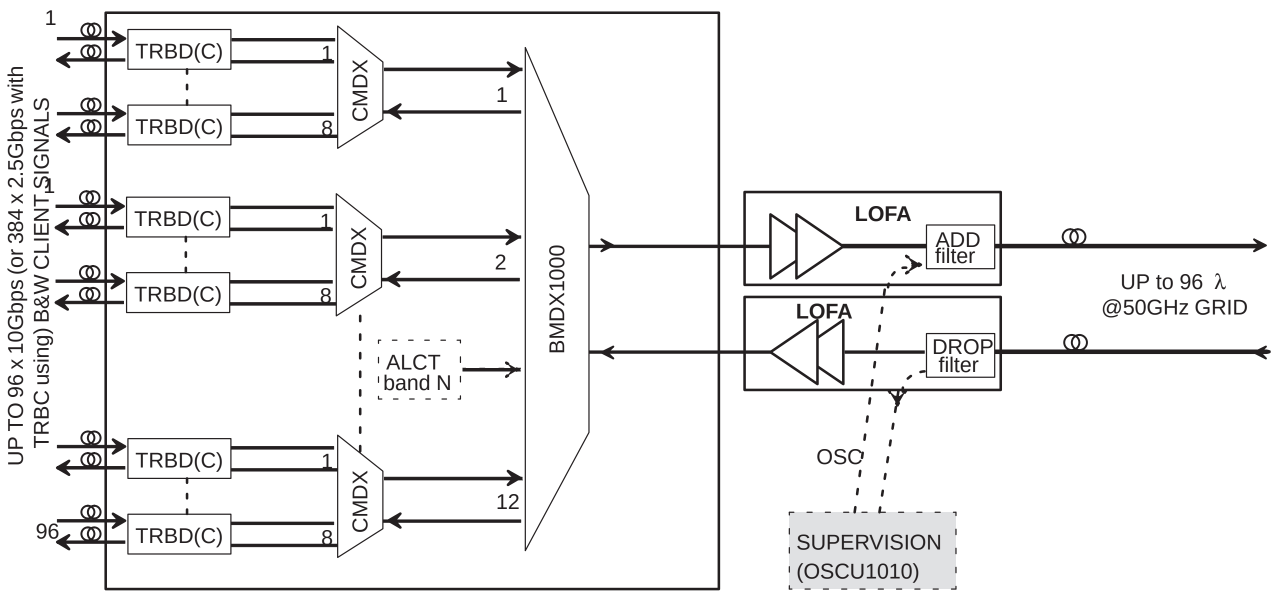


Figure 15. 1626 LM line terminal configuration

1.2.2 Line Repeater (LR)

In Line Repeater configuration the 1626 LM is a bidirectional DWDM amplifier without transponder nor MUX/DEMUX functions.
The line repeater consists of two optical double–stage in–line amplifiers (providing a bidirectional DWDM amplifier) in order to boost the optical power of the aggregate WDM signal avoiding channels demux and regeneration (no optical to electrical conversion).
The equipment takes place as line repeater in point–to–point and (multi)point–to–multipoint links.
From release 2.0 the Line Repeaters are coming from the 1626 LM.

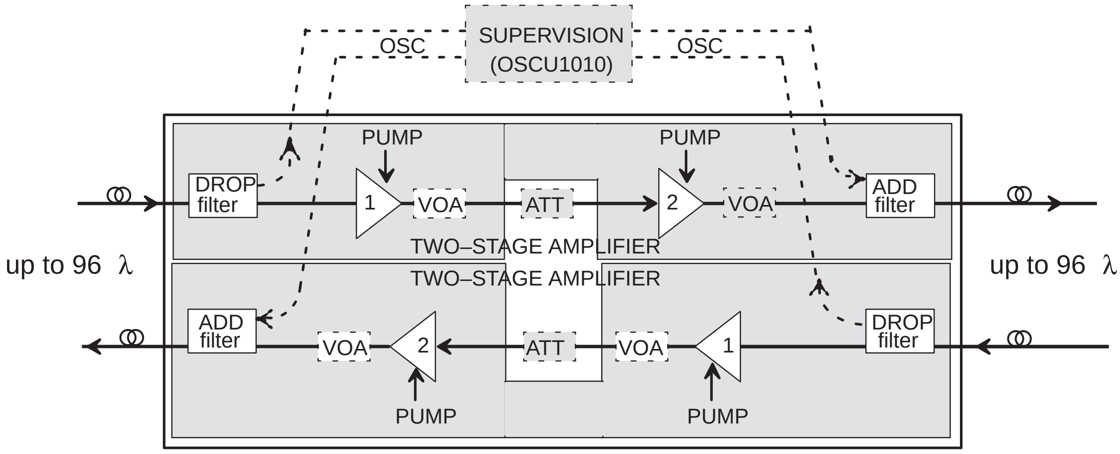


Figure 16. 1626 LM Line Repeater configuration

1.2.3 Optical Add and Drop Multiplexer (OADM) repeater (OR)

The OADM repeater is a Line Repeater with the capabilities to add and drop one or more wavelenghts to/from the aggregate signal in both directions.
Up to 100% of the wavelengths (12 bands) can be added/dropped.
All the bands that are not extracted are in complete pass–through, without any regeneration.
The OR is placed in (multi)point–to–multipoint (linear and ring) links.
This configuration type allows the Sub–Network Connection Protection (SNCP) of the added and dropped channels.
It is based on a MUX/DEMUX pair in back–to–back configuration, located between 2 line repeaters.

The OADM repeater is made up of

– line amplifiers (LOFA), with the extraction/insertion of the OSC before/after the double–stage amplifier
– up to 22 CMDX (11 per direction, 1 band is occupied by ALCT, default = B5) and 2 BMDX1100 (1 per direction) providing the 1626 LM mux/demux scheme
– transponders (TRBC and/or TRBD).
– ALCT allowing system loading and (optional) OSCU providing NE(s) supervision

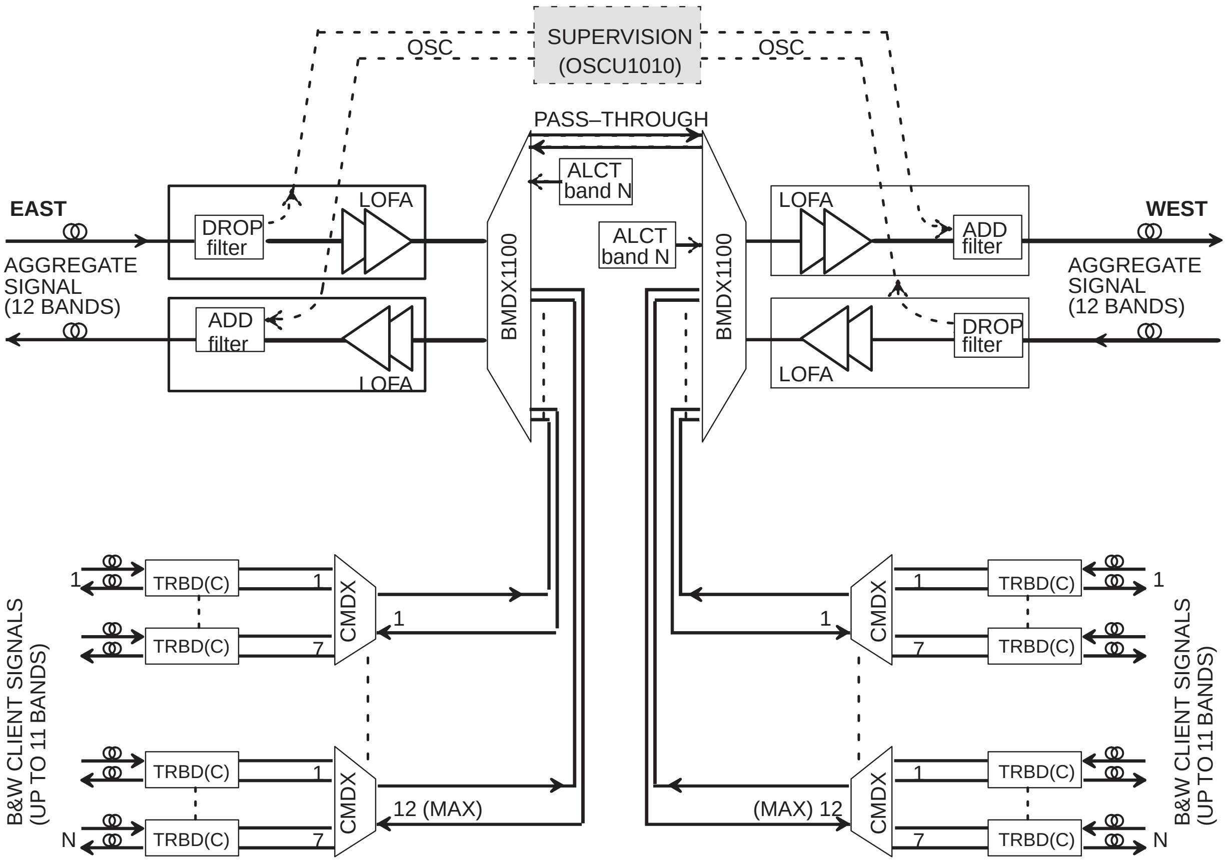


Figure 17. 1626 LM OADM configuration

1.2.4 Back to back terminal (BT)

The back to back terminal is a single NE grouping two line terminal configurations giving the capability to address both East and West direction of a link/ring.
It has both add and drop and 3R regeneration capabilities.
Up to 96 channels/wavelengths (12 bands) are added/dropped or regenerated in current release.
This configuration type allows the Sub–Network Connection Protection (SNCP, provided in future release) of the added and dropped channels.
It is made up of

- line amplifiers LOFA), with the extraction (resp. insertion) of the OSC before (resp. after) the double–stage amplifier
- two specular 1626 LM line terminal equipments with the 1626 LM mux/demux scheme (1 BMDX1000 and 12 CMDXs per direction) and transponders (TRBC and/or TRBD).

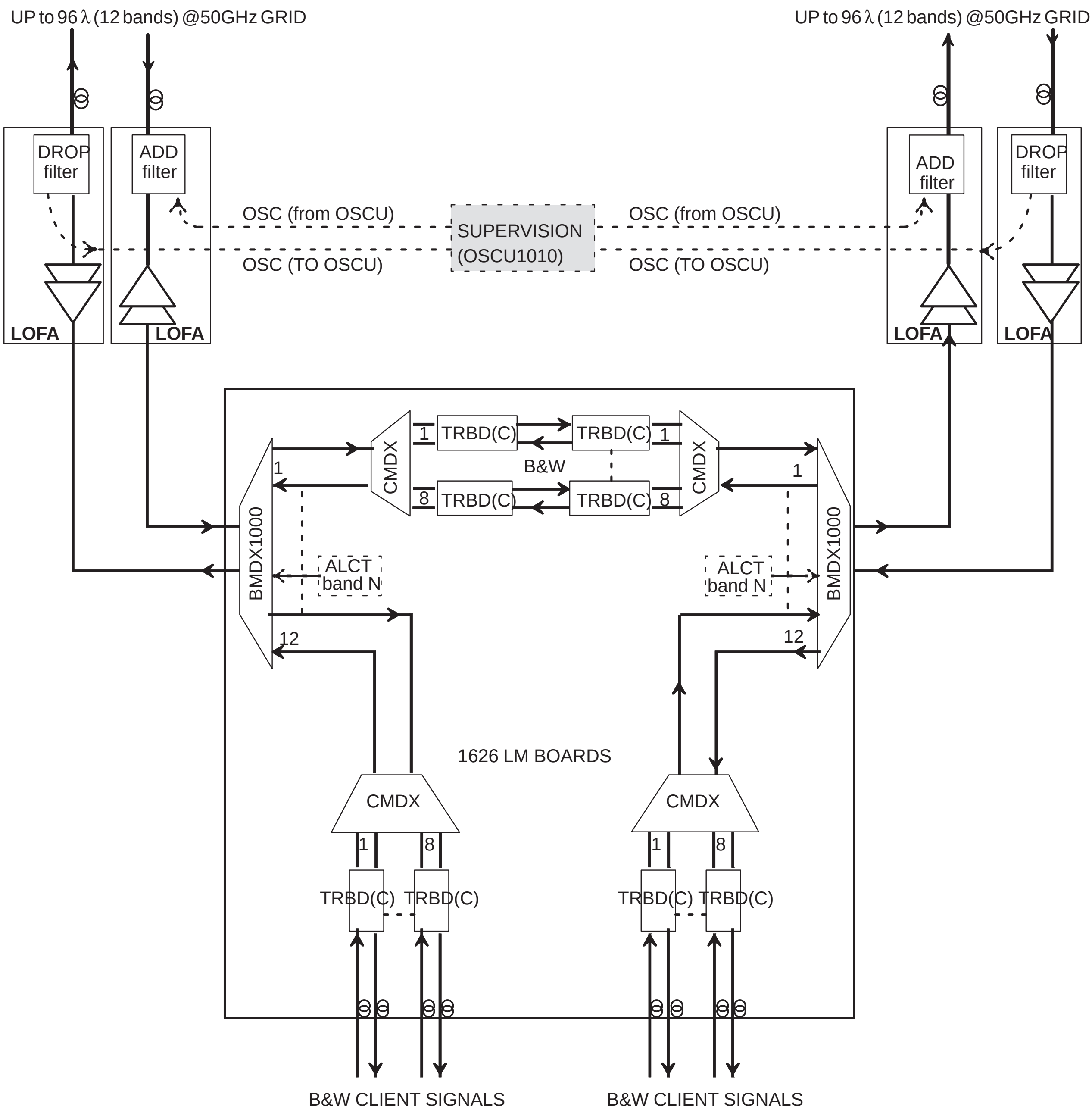


Figure 18. 1626 LM back–to–back terminal configuration

1.3 Rel. 1.x equipment basic configurations

The 1626 LM design, allows the following basic configurations of the equipment:

- line terminal (LT)
- line repeater (LR)
- High / low capacity Optical Add and Drop Multiplexer (OADM) repeater (OR)
- Back–to–back terminal (BT).

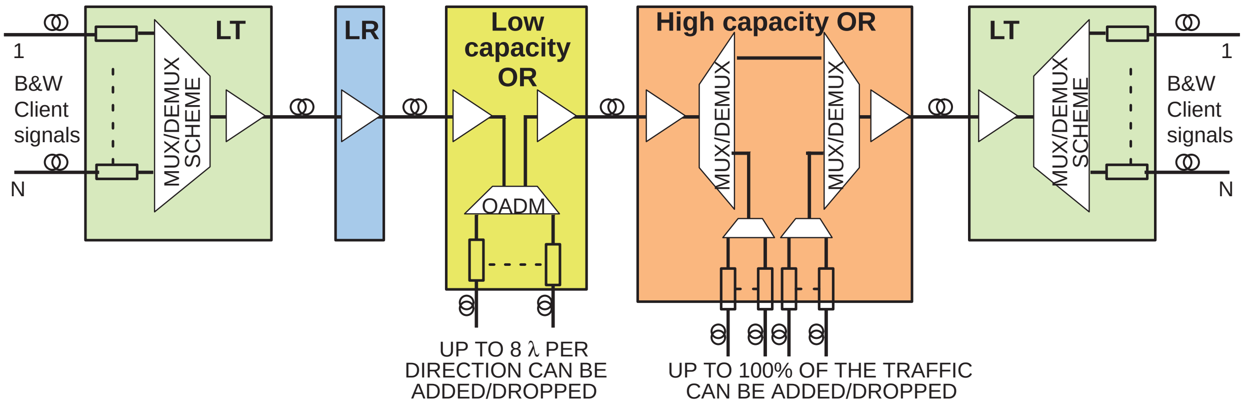


Figure 19. Example of WDM line

As in rel. 1.x the 1626 LM is not a stand–alone NE, it is necessary taking into account that the following paragraphs refer to

- 1640 WM and 1686 WM existing links upgrade with 1626 LM mux/demux scheme and/or transponders
- 1626 LM Rel.1.x new (greenfield) installations with 1640 WM and 1686 WM boards.

Note that

- in upgrade installation, both 1626 LM and 1640 WM / 1686 WM tributaries are present
- in new installation (greenfield), only 1626 LM transponders are pesent; **N.B.** colored signals coming from external Alcatel equipments (i.e. ADM/OMSN or DXC/OMSG) can be directly connected to the system Mux/Demux without any regeneration.
- the mux/demux scheme, according to the configuration, can be made up of both the 1626 LM and 1640 WM/1686 WM mux/demux
- supervision (OSC) and line amplifiers (booster+preamplifier) belong to the 1640 WM or 1686 WM.
- WLA is the 1686 WM transponder, TRB is the 1640 WM transponder, TRBD is the 1626 LM transponder, TRBC is the 1626 LM concentrator.

The OSC allows the NE management: it is extracted from the aggregate signal before entering the pre–amplifier and then added after the optical amplification of the aggregate signal. This gives the benefit to remotely manage the NE also in case of optical amplifier failure.

In the following paragraphs/figures

- CMDX stands for Channel Mux/Demux (8:1/1:8 mux/demux)
- BMDX stands for Band Mux/Demux (BMDX1000) in line terminal and back–to–back terminal configuration or Band OADM (BMDX1100) in OADM configuration
  - the BMDX1000 supports up to 8 wavelengths per band but not allows the band pass–thru (in back–to–back configuration) functionality
  - the BMDX1100 supports up to 7 wavelengths per band and allows the full transparent pass–thru at band level

In the next block schemes, only Tributary Direct Transponders (TRBD) with one 10 Gbps B&W client signal and one coloured 10 Gbps signal, are taken into account. **From current release is also available the Tributary Concentrator (TRBC) with 4 x 2.5Gbps B&W client signals and one coloured 10Gbps signal but it is not shown in the following figures, for semplicity reason.**
In the following are detailed the various configurations associated to Rel.1.x.
The upgrade design shown in the following paragraphs, requires dedicated design according to the link characteristics.

1.3.1 Line Terminal (LT)

In Line Terminal configuration (LT), the 1626 LM connects, according to the system architecture,

– up to 80 x 10Gbps B&W client signals, with TRBD using, or
– 320 x 2.5Gbps B&W client signals, with TRBC using

to an optical fibre DWDM line. Mixed configuration are allowed.
The LT is placed at the ends of point–to–point links.

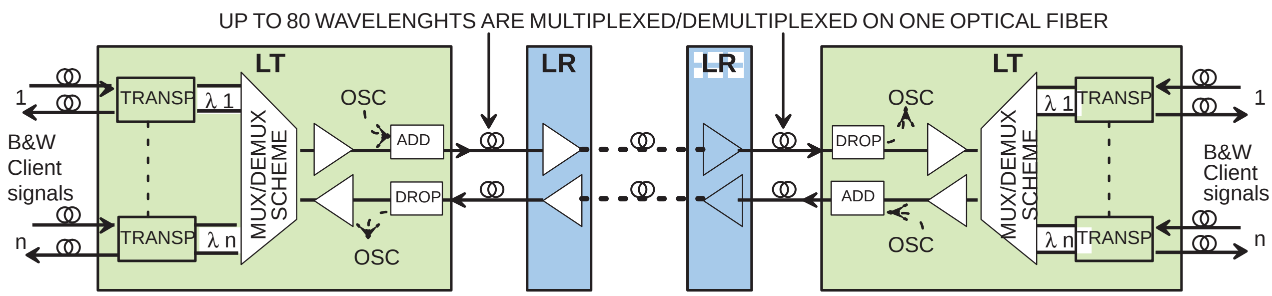


Figure 20. Generic example of LT configuration in point–to–point application

1.3.1.1 Line terminal equipment built–up of 1626 LM and 1640 WM

In the following is given a brief description of the two different **1640 WM mux/demux schemes**

– the **TCS** scheme is based on 3 mux/demux stages (only the B&W to WDM direction is described):
  • the first one is able to multiplex (or de–multiplex because the boards are bi–directional) up to 8 channels on a 200GHz grid (function supported by the TCS1xx, TCS302 and TCS401 boards)
  • the second one can mix up to 5 aggregate signals of 8 channels to reach 40 wavelengths on a 100GHz grid (supported by the TCS302, Off–grid channels, and TCS401, On grid channels);
  • the third one combines the two resulting aggregate signals of 40 channels at 100GHz to have one DWDM signal of 80 channels at 50GHz in C band (function provided by the TCS401 board).
– The **MDX** multiplexing architecture is based on two mux / demux stages
  • the first one is able to multiplex (or de–multiplex because the boards are bi–directional) up to 40 channels on a 100GHz grid; this function is supported by the MDX3x2 (On grid channels) and MDX3x3 (Off–grid channels).
  • the second one interleaves the two resulting aggregate signals of 40 channels at 100GHz to have one DWDM signal of 80 channels at 50GHz in C band (by means of the MDX4x1 board).

Existing 1640 WM links upgrade with 1626 LM boards

Figure 21. shows the upgrade scheme with the **TCS401** mux/demux scheme.
Upgrade of 1640WM with **TCS301** is not possible, you should replace this board by a TCS401 first.
The upgrade is allowed only when only when less than 40 channels of the 1640 WM system are installed.
Whatever the actual number “N” of installed channels ($\leq$ 40), all the remaining 80–“N” channels can be added with 1626 LM transponders + Mux/Demux (CMDX, BMDX).
The 1626 LM aggregate signal is connected to the unused input/output port of the 2:1 combiner/1:2 splitter of the TCS401 board.
The upgrade configuration connecting directly the 1626 LM tributaries with the TCS boards is not allowed.

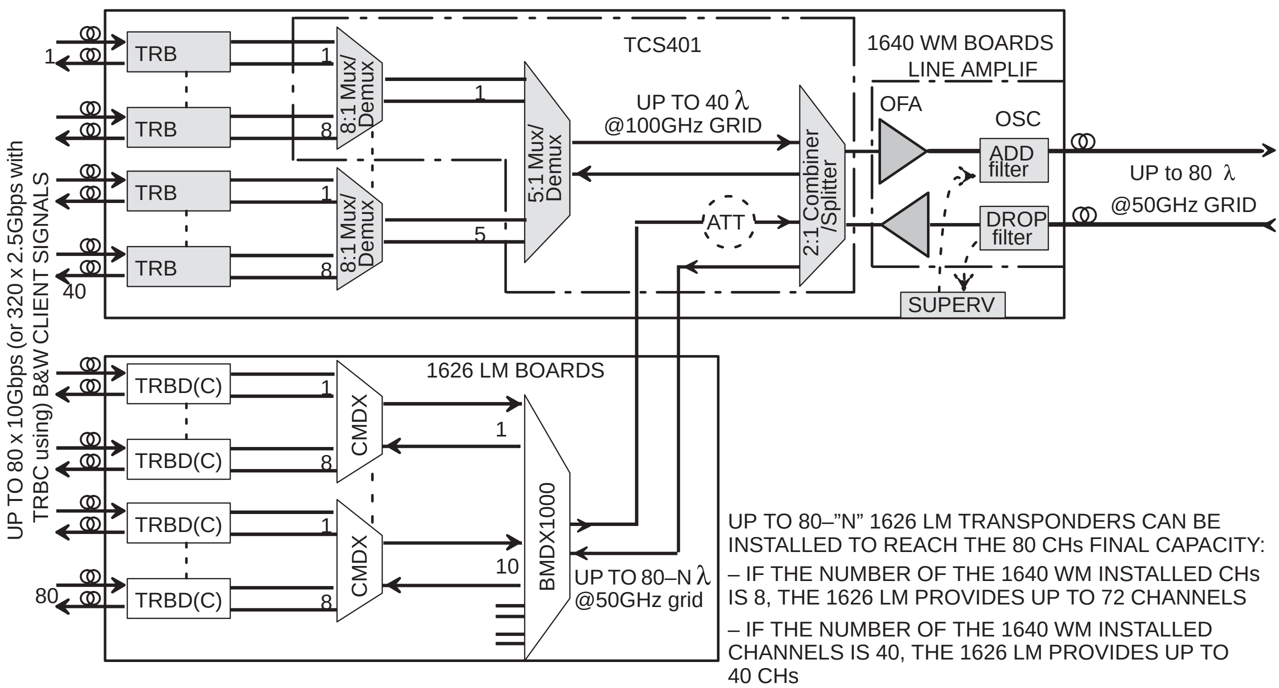
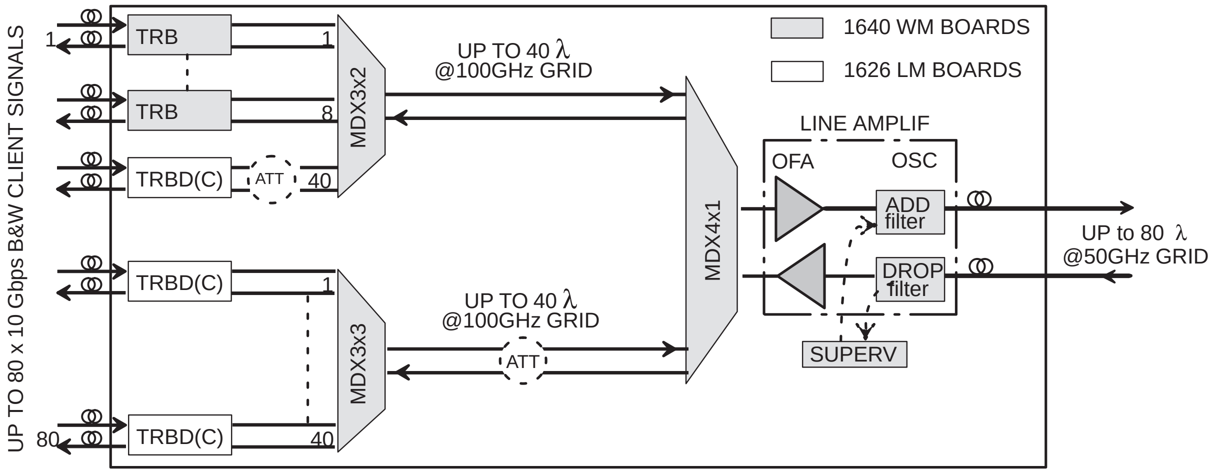


Figure 21. Upgrade of the 1640 WM based on TCS401 in line terminal configuration

Figure 22. shows the upgrade scheme with the **MDX401** mux/demux scheme.
Whatever the actual number "N" of installed channels the remaining 80–"N" channels can be filled with 1626 LM transponders directly connected to the MDX3xx boards of the 1640 WM mux/demux scheme.
It is not allowed to upgrade an already installed 1640 WM system (with MDX4xx and MDX342 boards) with the 1626 LM mux/demux scheme (instead of MDX343) connected to the MDX4x board.



80–"N" 1626 LM transponders can be used to complete the channel count to 80 channels with direct connection to the MDX342 and MDX343 mux/demux of the 1640 WM.

Figure 22. Upgrade of the 1640 WM based on MDX in line terminal configuration

New (greenfield) 1626 LM links installation with 1640 WM boards

Figure 23. shows the 1626 LM Rel.1.x greenfield installation scheme. It is based on

– transponders, Mux/Demux (CMDX, BMDX) boards, belonging to the 1626 LM
– optical amplifiers, MDX4*, OSC, ALC (all remaining equipment) boards, belonging to the 1640 WM.

MDX4* provides APSD control and ALC insertion.

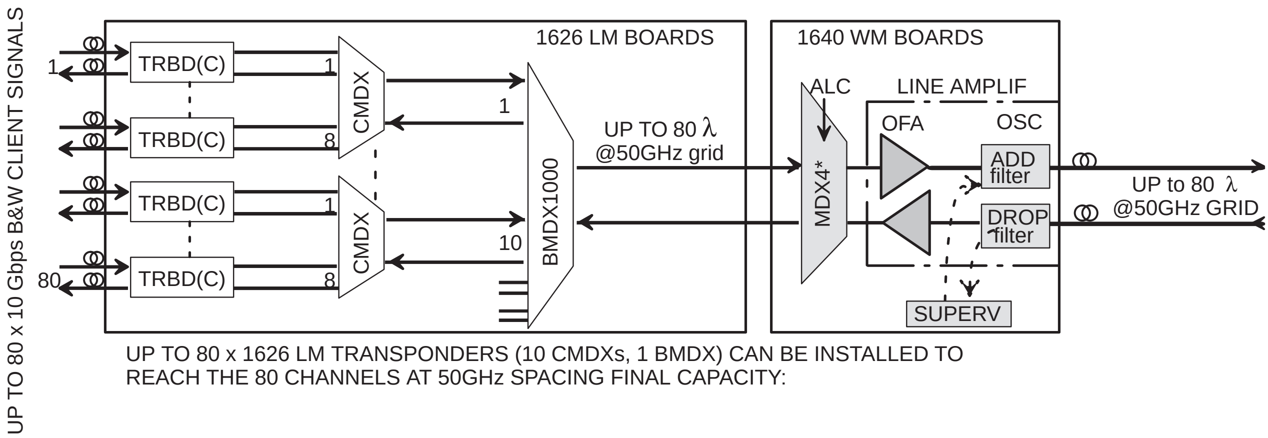


Figure 23. Line Terminal: 1626 LM greenfield installation with the MDX4*–based 1640 WM

1.3.1.2 Line terminal equipment built–up of 1626 LM and 1686 WM

Hereinafter, a brief description of the 1686 WM mux/demux scheme is given.
It is based on two mux/demux stages

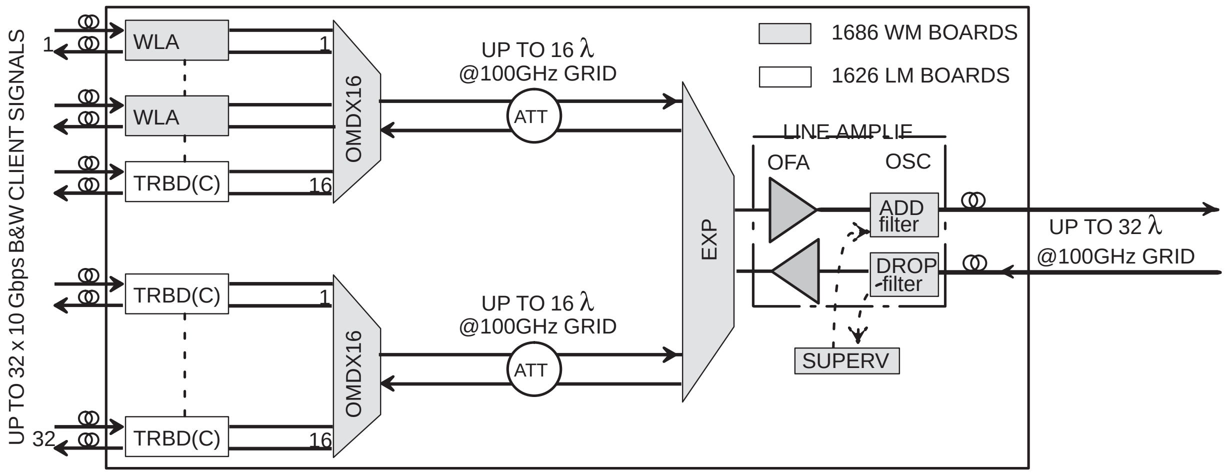
– the first one is made up of two OMDX boards, able to multiplex (or de–multiplex, because the boards are bidirectional) up to 16 chs each (one in red band, the other one in blue band) on a 100GHz grid
– the second one multiplexes the two resulting aggregate signals of 16 channels at 100GHz each to have one DWDM signal of 32 channels at 100GHz in C band (by means of the expansion board).

Existing 1686 WM links upgrade with 1626 LM boards

Two cases of upgrade are allowed:

– 1626 LM mux–demux connected to 1686 WM EXP board
– 1626 LM tributaries (transponders) directly connected to 1686 WM mux–demux.

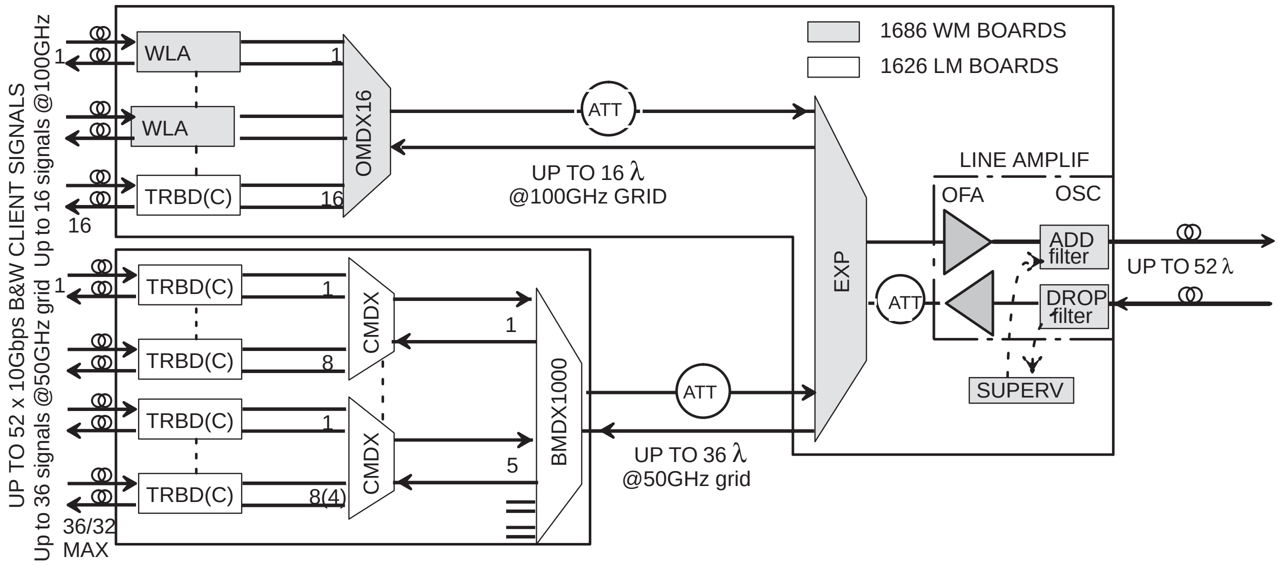
Figure 24. shows the upgrade scheme with the **1626 LM transponders directly connected to the 1686 WM mux/demux.**
This configuration allows to multiplex/demultiplex up to 32 channels to/from the DWDM line
This upgrade is always possible, whatever the actual number “N” of installed channels. The remaining 32–“N” channels can be filled with 1626 LM transponders directly connected to the OMDX16 boards of the 1686 WM mux/demux scheme.



32–”N” 1626 LM transponders can be used to complete the channel count to 32 channels with direct connection to the OMDX16 mux/demux boards of the 1686 WM.

Figure 24. 1686 WM system upgrade with 1626 LM transponders in Line Terminal configuration

Figure 25. shows the 1686 WM upgrade scheme with the **1626 LM mux/demux scheme connected to the expansion board of the 1686 WM.**
This configuration is possible when only one 1686 WM Mux/Demux is installed (up to 16 chs), allowing the connection of the 1626 LM mux/demux to the unused port of the 1686 WM EXP board. Hence it is possible to increase the channels number to more than 32 filling the available band with 50GHz spaced chs.
To summarize, the possible upgrade configurations with 1626 LM transponders and mux/demux, are
– up to 36 x 1626 LM channels in the Red band for 52 chs final system capacity with the +20 dBm OFA



UP TO 36 1626 LM TRANSPONDERS IN RED BAND OR UP TO 32 TRANSPONDERS IN BLUE BAND, CAN BE ADDED
IN CASE OF 36 (1626 LM) CHANNELS UPGRADE, 5 CMDXs ARE REQUIRED
IN CASE OF 32 (1626 LM) CHANNELS UPGRADE, 4 CMDXs ARE REQUIRED

Figure 25. 1686 WM system upgrade with the 1626 LM mux/demux scheme in LT configuration

New (greenfield) 1626 LM links installation with 1686 WM boards

The greenfield configuration is the same reported in
– Figure 24. on page 67 showing the 1686 WM system upgrade with 1626 LM transponders directly connected to the 1686 WM mux/demux)
– Figure 25. on page 68 showing the 1686 WM system upgrade with the 1626 LM mux/demux scheme connected to the 1686 WM expansion board

but with 1626 LM transponders only (no 1686 WM transponders).

1.3.2 Line Repeater (LR)

The line repeater consists of two optical double–stage in–line amplifiers (providing a bidirectional DWDM amplifier) in order to boost the optical power of the aggregate WDM signal avoiding channels demux and regeneration (no optical to electrical conversion).
The equipment takes place as line repeater in point–to–point and (multi)point–to–multipoint links.
In current release the Line Repeaters are coming from the 1686 WM/1640 WM without any modifications.

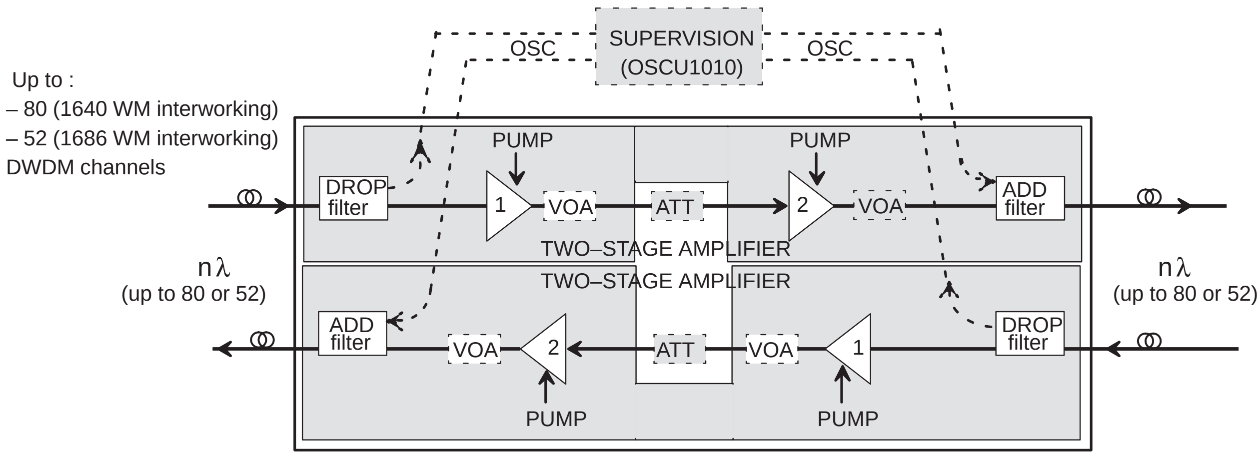


Figure 26. Line Repeater configuration

1.3.3 Optical Add and Drop Multiplexer (OADM) repeater (OR)

The OADM repeater is a Line Repeater with the capabilities to add and drop one or more wavelenghts to/from the aggregate signal in both directions.
The OR is placed in (multi)point–to–multipoint (linear and ring) links.
We can have two types of OADM Repeater

- low capacity OADM Repeater in interstage configuration
- high capacity OADM Repeater in span configuration

1.3.3.1 Low capacity OADM Repeater in interstage configuration

The OADM repeater is made up of
– line amplifiers, with the extraction/insertion of the OSC before/after the double–stage amplifier
– OADM board, able to add/dro up to 4/8 channels per direction (east/west) according to the board type
– transponders.

In **upgrade** installation, only 1626 LM transponders, directly connected to the 1686 WM (see Figure 27.) or 1640 WM (see Figure 28.) OADM boards, can be added to the already installed 1686/1640 WM system (line amplifiers, OADM and transponders).

In **greenfield** installation, there are only 1626 LM transponders directly connected to the 1686 WM (see Figure 27.) or 1640 WM (see Figure 28.) OADM boards.

The maximum number of supported channels depends on the LT configuration:
– with the configuration of Figure 24. the max number of channels (λ) in the aggregate signal is 32.
– with the configuration of Figure 25. the max number of channels (λ) in the aggregate signal is 40 ÷ 45, depending on the upgraded band.

For example, in case of OADM8 using, it is possible to add/drop the following channels to/from the aggregate signal: 193100 GHz, 193300 GHz, 193500 GHz, 193700 GHz, 194300 GHz, 194500 GHz, 194700 GHz, 194900 GHz.
Due to the OADM board filter, the ± 50 GHz spaced (adjacent) frequencies (with respect to the added/dropped frequency), when used, are forbidden: i.e. the 193100 GHz added/dropped frequency, inhibites the 193050 GHz and the 193150 GHz frequencies (the allowed channels are shown in 1626 LM rel.1.0 and rel. 1.2 technical handbooks).
By considering a system upgraded in red band (hence the red band channels are 50 GHz spaced, while the blue band channels correspond to the already installed 1686 WM part, 100 GHz spaced), we can see that the 193050 GHz, 193150 GHz, 193250 GHz, 193350 GHz, 193450 GHz, 195550 GHz and the 196650 GHz channels are forbidden by the OADM8 board using (the 193750 GHz and 194250 GHz are guard band, while the other frequencies are in blue band, 100 GHz spaced by the already installed 1686 WM system; thus there isn't any channel inhibited by the OADM filter).

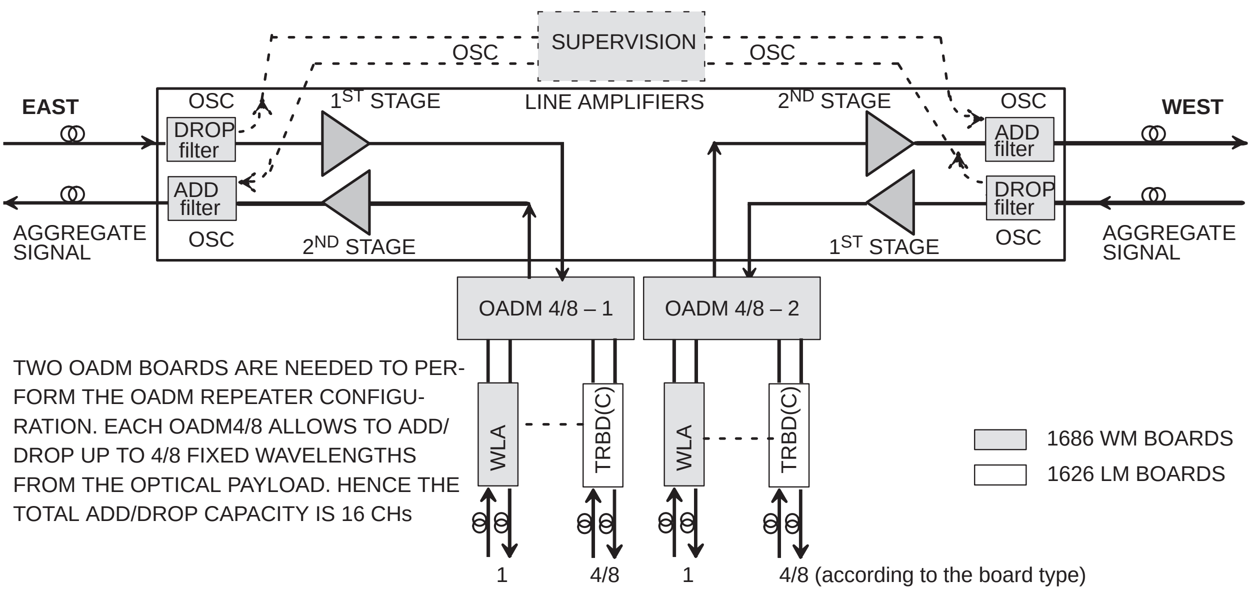


Figure 27. 1686 WM system upgrade with 1626 LM transponders in low capacity OADM configuration

If the mux/demux scheme is based on MDX the max number of channels (λ) in the aggregate signal is 59 ÷ 69
If the mux/demux scheme is based on TCS the max number of channels (λ) in the aggregate signal is 62 ÷ 72

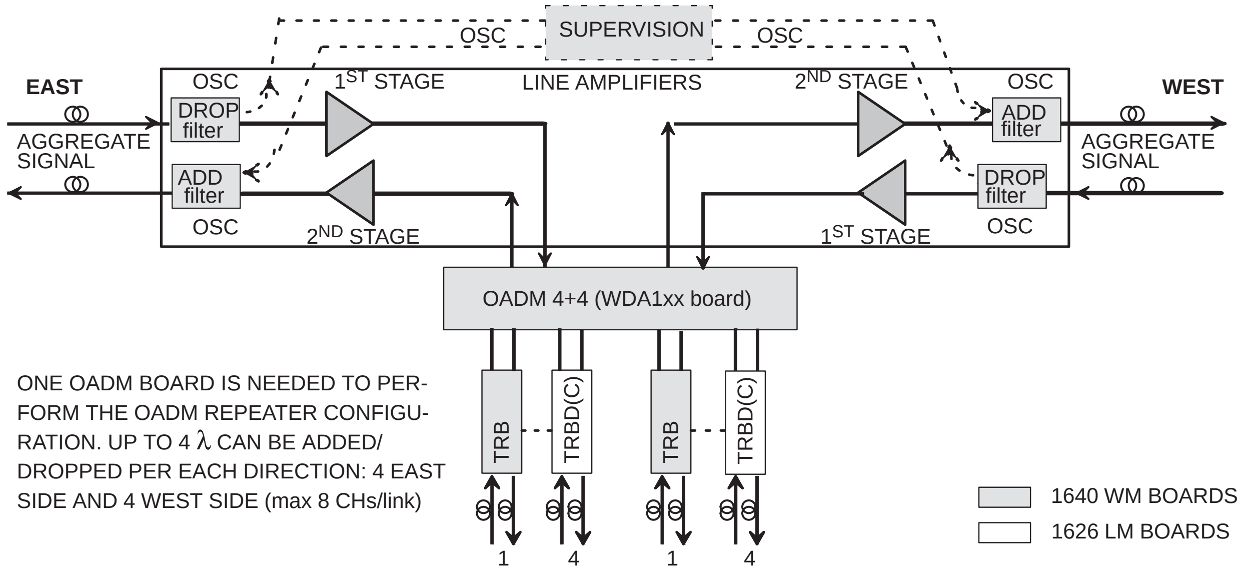


Figure 28. 1640 WM system upgrade with 1626 LM transponders in low capacity OADM configuration

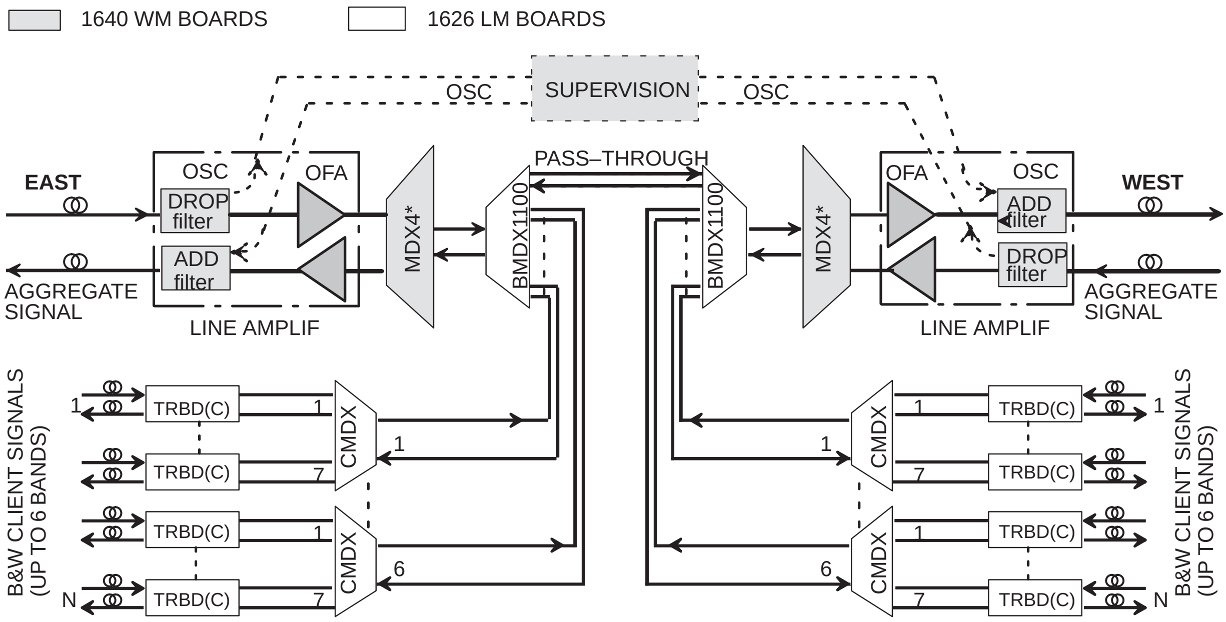
1.3.3.2 High capacity OADM Repeater in span configuration

The high Capacity OADM repeater is able to add and drop up to **100% (in aymmetric configuration) or up to 60% (in symmetric configuration) of the traffic** of the DWDM line.
It is based on a MUX/DEMUX pair in back–to–back configuration, located between 2 line repeaters.
All the bands that are not extracted are in complete pass–through, without any regeneration.

In **upgrade** installation, only 1626 LM transponders directly connected to the mux/demux scheme, can be added to the already installed system (line amplifiers, mux/demux and transponders).

In **greenfield** installation, the following configuration is foreseen:

– 1626 LM mux/demux scheme connected to the 1640 WM MDX4* boards, see Figure 29.



THE OADM BMDX IS A BMDX OPTICALLY COMPATIBLE WITH OADM APPLICATIONS. THE OADM REPEATER IS ABLE TO ADD/DROP OR PASS THROUGH UP TO:
– 11 BANDS (THE OTHER BAND BEING KEPT FOR A LOADING CHANNEL (ALCT)
– 7 CHANNELS PER BAND
(THESE FIGURES ARE VALID IN THE LIMIT OF THE SYSTEM CAPABILITY: 2 RACKS MAX...)

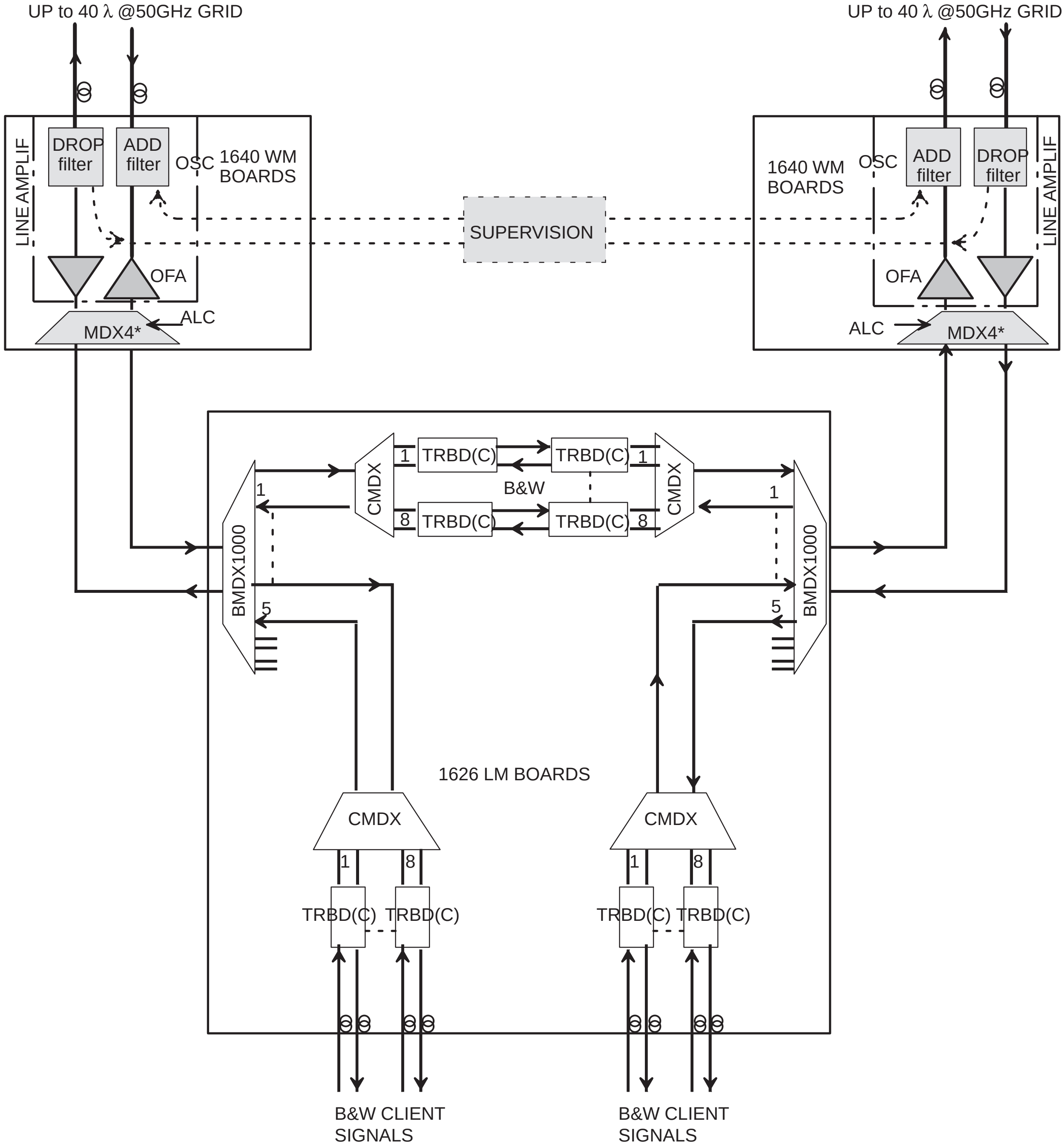
Figure 29. Greenfield installation with a 1640 WM line in high capacity OADM configuration

1.3.4 Back to back terminal (BT)

The back to back terminal is a single NE grouping two line terminal configurations giving the capability to address both East and West direction of a link/ring.
It has both add and drop and 3R regeneration capabilities.

Up to 40 channels (5 bands) are managed in current release.
It is made up of

– 1640 WM line amplifiers, with the extraction/insertion of the OSC before/after the double–stage amplifier
– two specular 1626 LM line terminal equipments with the 1626 LM mux/demux scheme (BMDXs and CMDXs) and 1626 LM transponders.



UP TO 80 x 1626 LM TRANSPONDERS (TRBD, TRBC), 10 CMDXs and 2 BMDX1000 HAVE TO BE INSTALLED TO REACH THE 40–CHANNEL (AT 50GHz SPACING) CAPACITY IN BACK–TO–BACK TERMINAL CONFIGURATION.

Figure 30. Greenfield installation with a 1640 WM line in back–to–back terminal configuration

1.4 Network architectures

The following architectures are foreseen:

– point–to–point
– (multi)point–to–multipoint, both in linear, ring and meshed topologies

1.4.1 Point to point links

Point–to–point links can be performed by means of the following NE configurations
– line terminal, located at each end of the link, that multiplexes/de–multiplexes the tributary signals
– line repeater, that amplifies the aggregate signal without the need of optical to electrical conversion

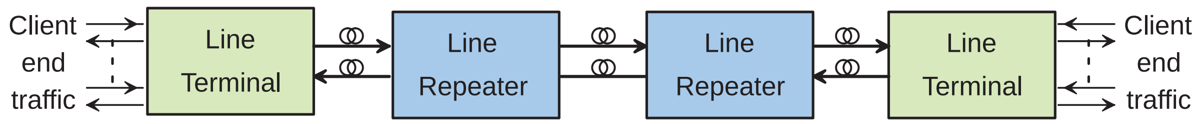


Figure 31. The 1626 LM in point–to–point links

1.4.2 (Multi)point–to–multipoint links

(Multi)point–to–multipoint links can be performed by means of some of the following configurations
– line terminal, located at each end of the link, that multiplexes/de–multiplexes the tributary signals
– line repeater, that amplifies the aggregate signal without the need of optical to electrical conversion
– OADM repeater, able to add/drop a part (up to 100%) of the traffic
– Back–to–back terminal, able to add/drop up to 100% of the aggregate signal.

1.4.2.1 Linear (multipoint to multipoint) links

As shown in Figure 32. line terminal, line repeater and OADM repeater configuration can be used to establish linear (multipoint to multipoint) links.

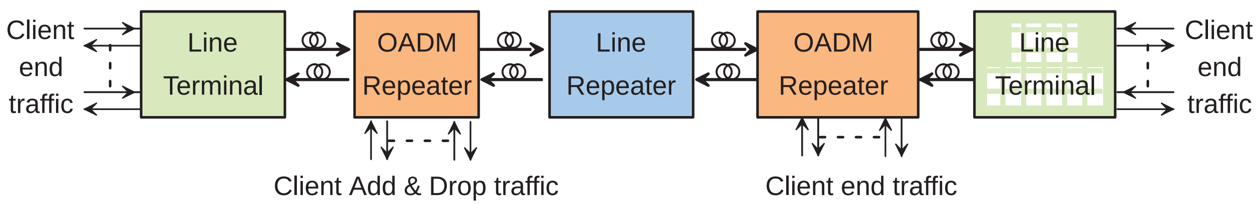


Figure 32. The 1626 LM in linear (multipoint–to–multipoint) links

1.4.2.2 Ring (multipoint to multipoint) networks

Ring networks can be established by means of the back–to–back terminal, OADM repeater and line repeater configurations.

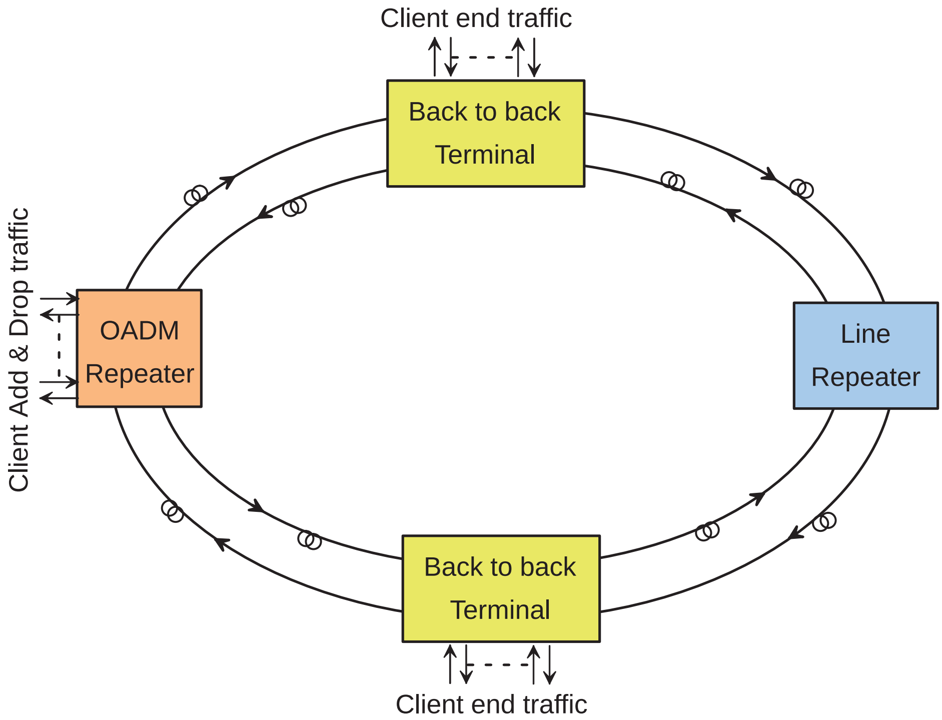


Figure 33. The 1626 LM in ring (multipoint–to–multipoint) networks

1.4.3 Host systems (ADM..)

Host systems can be all data equipments whose optical output signals have a bit–rate between 2.5 Gbps and 10 Gbps. They can be :

- SDH/SONET equipments (STM–16/OC–48, STM–64/OC–192 signals)
- IP routers
- SDH/SONET (STM–1/OC–3, STM–4/OC–12, GBEthernet, FC, FICON, ESCON equipments... (by means of 4xANY)
- 10GBEthernet WAN, 10 GBEthernet LAN

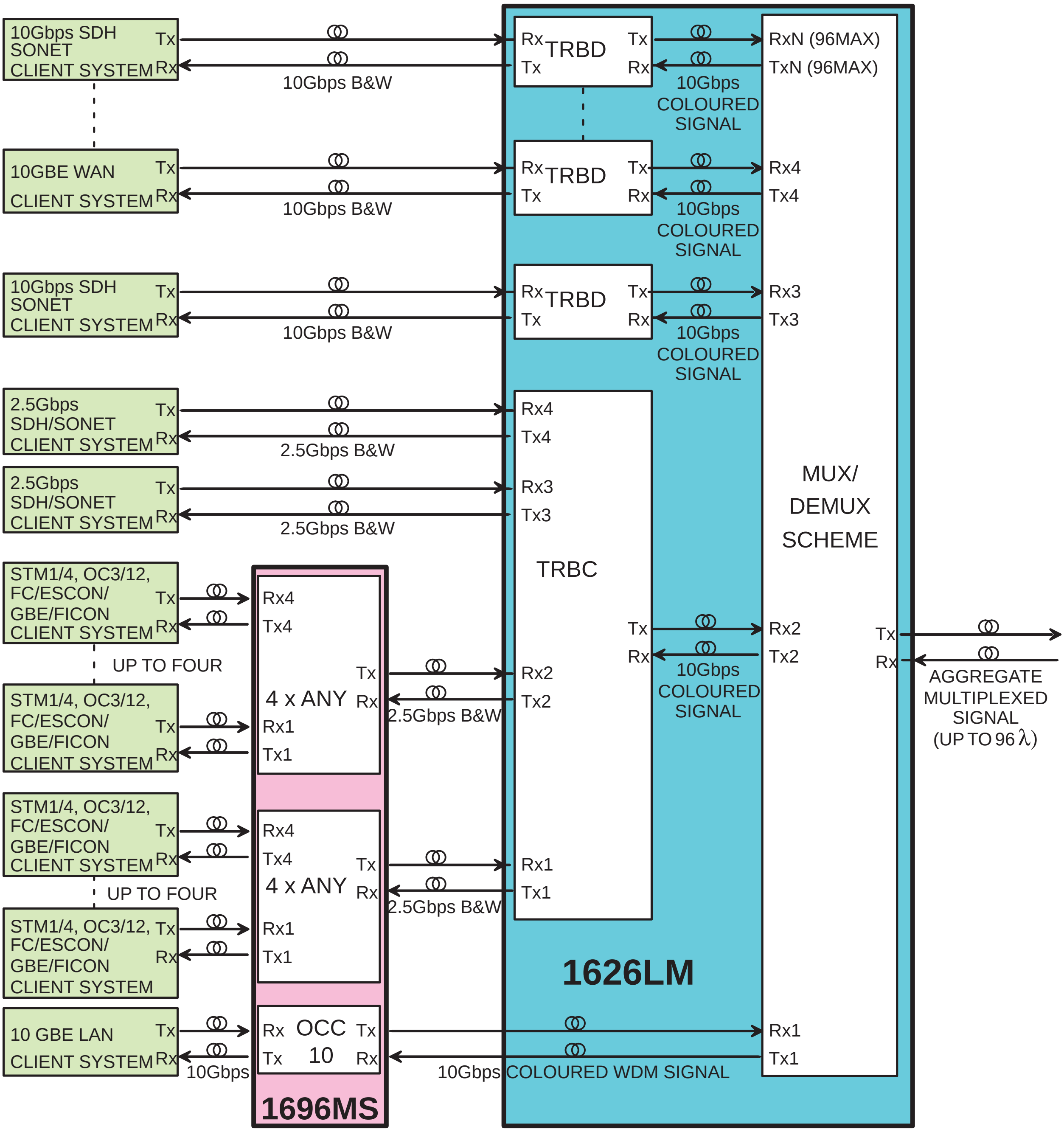


Figure 34. Connection to host equipments

1.5 Protections

The optcal protections are managed by means of an additional (OCP) equipment, able to provide to a generic host tributary system both linear and ring optical channel (OCh) protections.

Optical Channel (OCh) protection in linear links

The Optical Channel (OCh) protection in linear links (see Figure 35.) applies between two Line Terminal or between a Line Terminal and an OADM Repeater.
The tributary signal is bridged over two different lines (working and protecting line). In this way the signal is delivered towards two different paths. At the receiver side an optical switch selects between the two diversely routed signals. The protection is triggered by the Loss of Signal (LOS).

Optical Channel (OCh) protection in ring networks

The channel protection applied to a ring topology (see Figure 36.) is the Optical SNCP (O–SNCP, provided in future rel.) performed by means of the OCP equipment, as for the linear topology, by splitting the host tributary signal with a passive 1x2 splitter and routing the two output signals in the two opposite directions of the ring.
At the receiver side the signal is selected by means of a 1x2 optical switch and delivered to the host system. The switching criterion is the LOS and the optical switching time is as quick as tents of milliseconds.

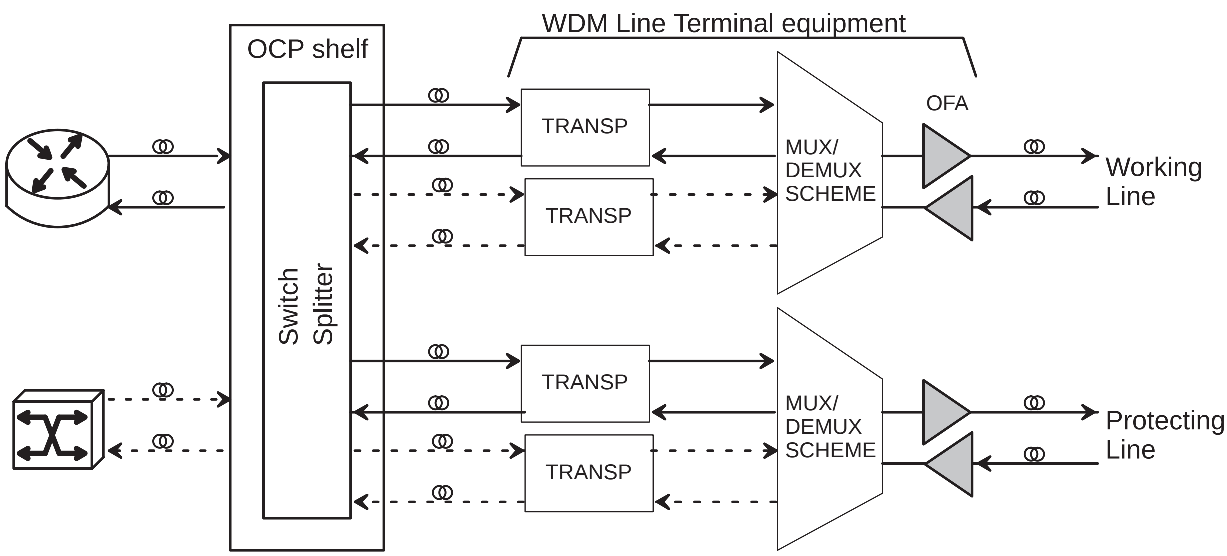


Figure 35. Optcal channel protection in linear links

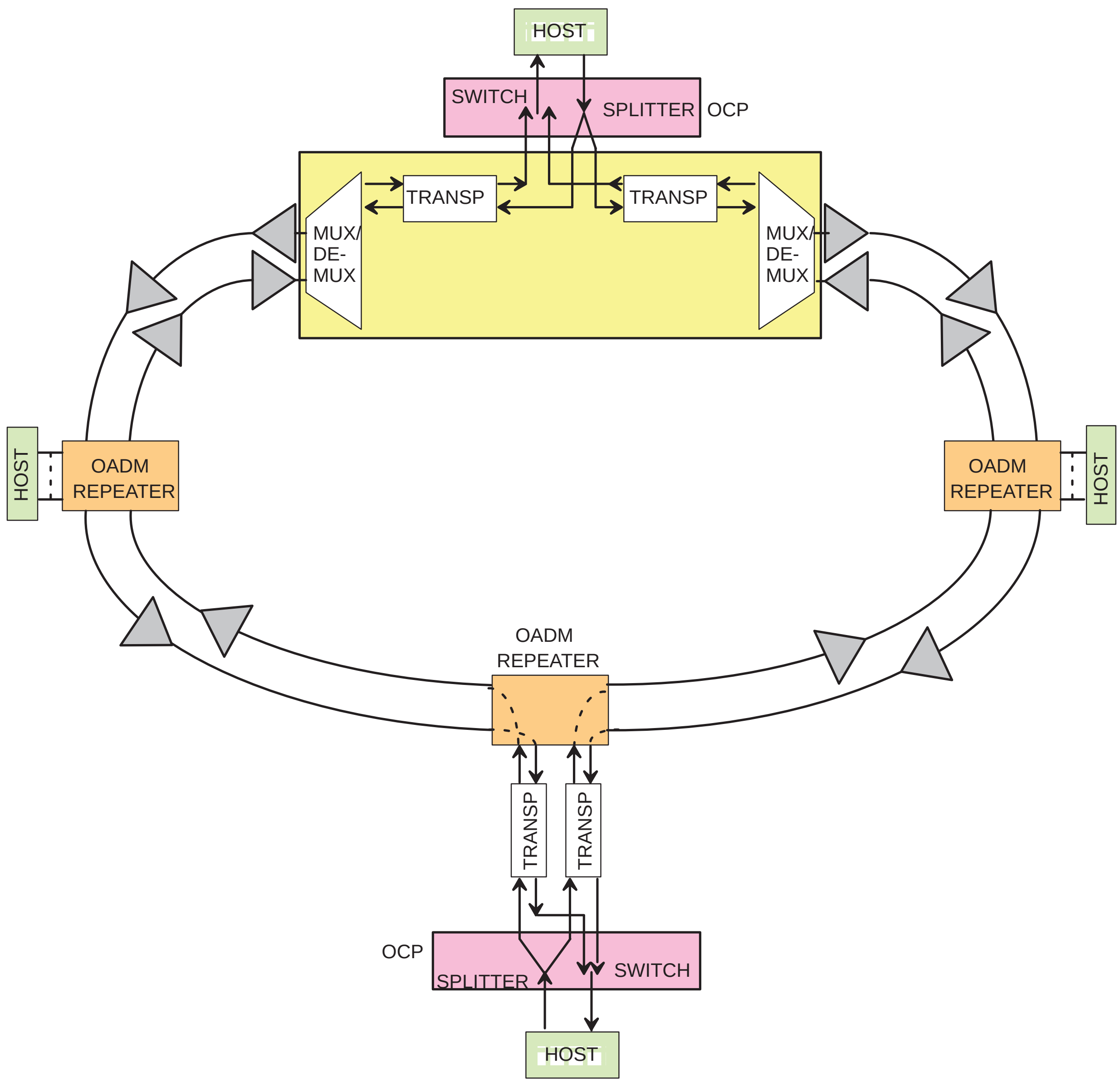


Figure 36. Optical SNCP protection scheme: with back–to–back terminals or OADM

The **split** and **select** functions are optically performed, by means of an optical switch and an optical splitter. The selection is done by shutting–down the user Tx corresponding to the path in failure and switching to the protecting one (see Figure 37.).

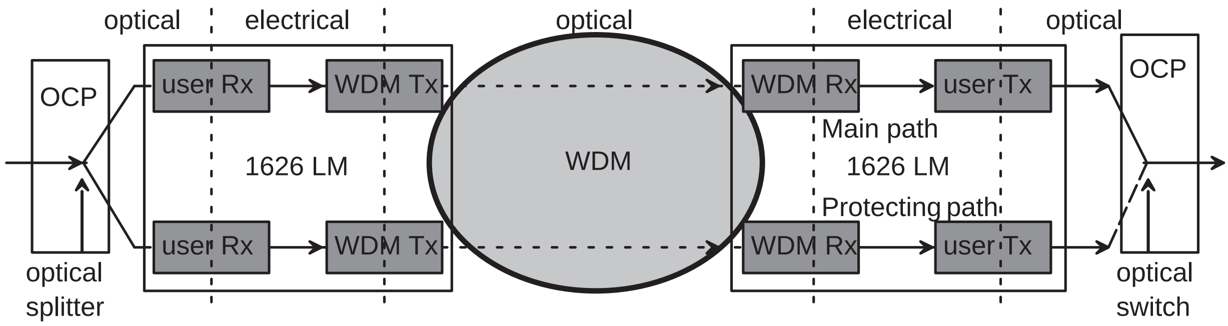


Figure 37. Optical protection way of working

2 PHYSICAL CONFIGURATION

The 1626 LM has been designed to offer a record size integration to meet the challenging requirements of the backbone environment.
A fully loaded 1626LM system with 96 channels (Line Terminal configuration) is housed by three standard ETSI racks.

The 1626 LM employs a common shelf type for the different network elements. Up to three 1626 LM shelves can be fitted into a single rack.

The NE composition, when the 1626 LM R.1.X is used with 1640 WM or 1686 WM line sections, is described in rel. 1.0 and rel. 1.2 technical handbooks, code 3AL 94720 AAAA and 3AL 94799 AAAA and it will not be considered in this document.

2.1 Rack design

The 1626 LM mechanical design allows to put up to **three shelves** in current release.
It is compatible with the following mechanical standard

– 2000 mm high ETSI rack.

In the 1626 LM R.2.0 up to two racks can be managed.
The depth is compliant with the 300 mm deep ETSI racks.

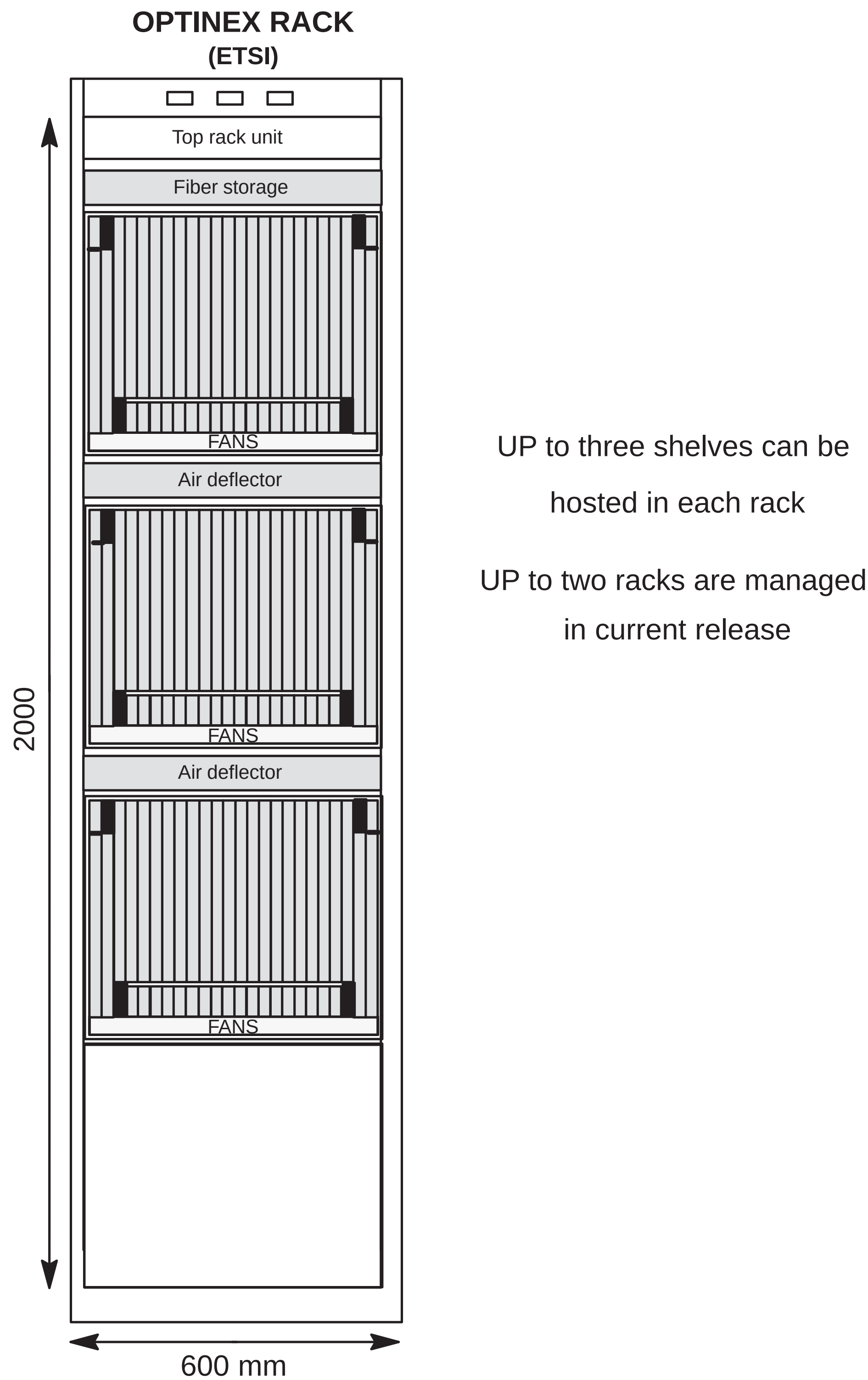


Figure 38. Rack organization

2.2 1626 LM shelf physical configuration

The 1626 LM shelf is made up by an empty shelf and the boards and units installed in it.
The 1626 LM system is composed by

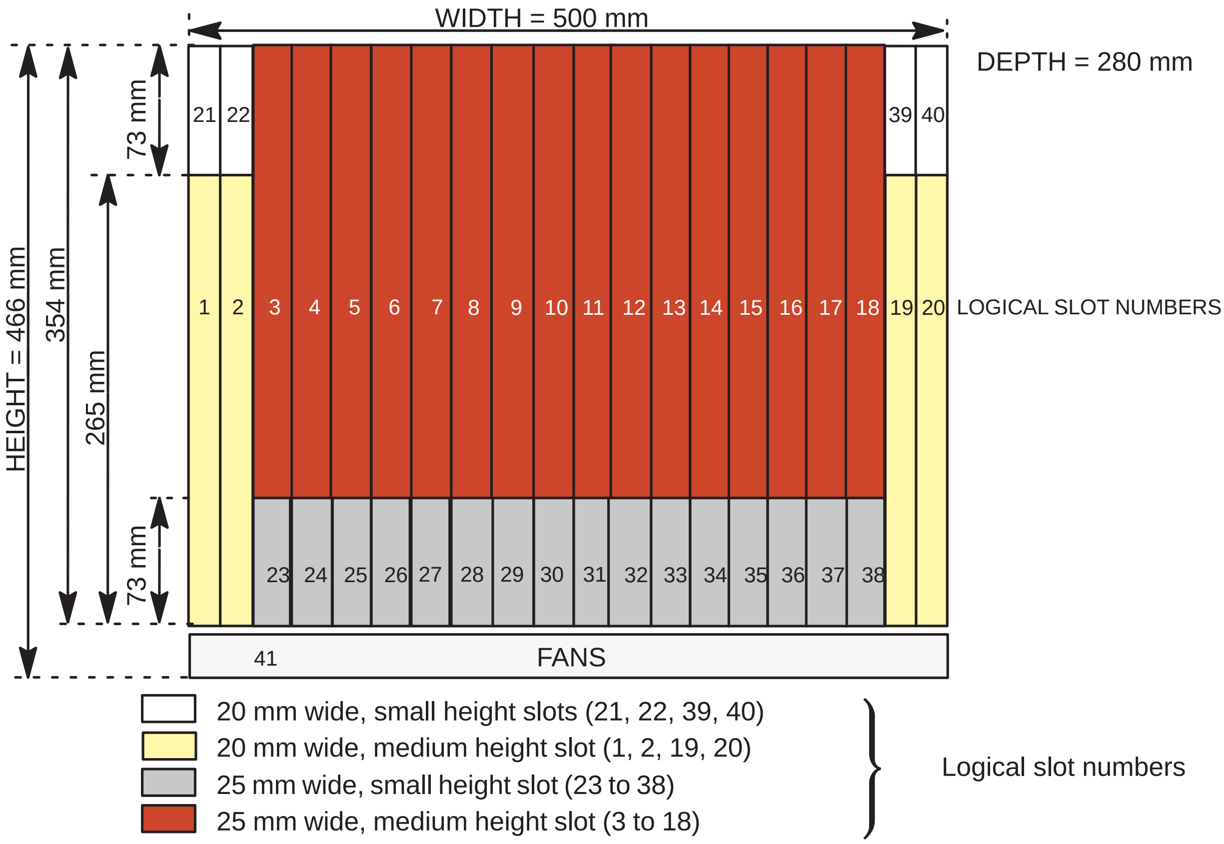
– one mandatory master shelf
– up to three slave/expansion shelves, according to the configuration type.

The board composition determines the shelf type: master or slave.

2.2.1 1626 LM Empty shelf

The shelf is divided in 41 slots. The logical slot numbers are shown in Figure 39.
Six different mechanics are available for the 1626 LM boards:

– 20 mm width, small height; this mechanic fits into slots 21, 22, 39 and 40
– 20 mm width, medium height; this mechanic fits into slots 1, 2, 19 and 20
– 25 mm width, small height; this mechanic fits into slots 23 to 38
– 25 mm width, medium height; this mechanic fits into slots 3 to 18
– 25 mm width, tall height; this mechanic takes two slots: one 25mm wide, medium height slot plus one 25mm wide, small height one which is under it. Thus, it fits in slots 3 plus 23, 4 plus 24 to 18 plus 38. The relevant units use the connector from the medium height slot to communicate with the SC
– double width, tall height (these boards are foreseen for future releases); this mechanic takes four slots: two adjacent 25 mm wide, medium height slots plus the two 25mm wide, small height ones which are under them. I.e. it can fit in slots 5, 6, 25, 26. The units which have this mechanics use the connector from the left medium height slot (slot 5 in the above example) to communicate with the SC.



A medium plus a small 25 mm width slots (3+23, 4+24,...,18+38) are required to install a tall height board.
20mm wide units can be fit into 25mm wide slots with the 5mm redactor plate.

Figure 39. Shelf dimensions and slots hardware and software numbering

2.2.2 1626 LM shelves configuration

This paragraph illustrates the physical structure, layout and composition, coding and partition of the shelves.
Some examples of the shelf front view are illustrated herebelow, in Figure 40. on page 83, Figure 41. on page 84 and Figure 43. on page 85.
The units codes and partition are listed in Table 9. on page 87.

The board composition and placement of a shelf respects some constraints at the hardware, software and functional levels. If general rules are followed, a certain number of standard configurations can be obtained in which boards can be exchanged without functionality loss.
In the following list are described the 1626 LM boards, the relevant location and the housing shelf (if no indication is provided, it means that the board can be equipped both in master and in slave shelf).

– Equipment and shelf controller (**ESCT1000**), medium height, is located in slot 1 of
  - the master shelf, providing both the Equipment and Shelf Controller functionalities
  - each slave/expansion shelf, providing only the Shelf Controller functionality

– 10 Gbps transponders (**TRBDwxyz**), tall height, located among slots 3 plus 23 and slot 18 plus 38

– Tributary Concentrators (**TRBC1111**), tall height, located among slots 3 plus 23 and slot 18 plus 38

– 8:1 50GHz grid Channel mux/demux (**CMDX101z**), medium height, in up to two slots among 2 to 19 (in slots 3 to 18, CMDX are equipped with the 5mm redactor plate); recommended slots are 2 and 19. In master shelf, it is typically plugged only one CMDX.
  The board plugged in slot 19, is dedicated to mux/demux the signals of the (up to eight) transponders fitted in slots from 11 plus 31 to 18 plus 38 of the same shelf.
  The board plugged in slot 2, is dedicated to mux/demux the signals of the (up to eight) transponders fitted in slots among 3 plus 23 and 10 plus 30 (of the same shelf)

– 12:1 Band mux/demux (**BMDX1000**), tall height, located in one or two slots among 3 plus 23 and 18 plus 38 of the master shelf; recommended slots are
  - 3 plus 23, in line terminal configuration
  - 3 plus 23 and 7 plus 27, in back–to–back terminal configuration; each board is connected to the relevant (up to twelve) CMDX101z

– 12:1 Band mux/demux for Band OADM (**BMDX1100**), tall height, located in two slots among 3 plus 23 and 18 plus 38 of the master shelf; recommended slots are 3 plus 23 and 7 plus 27. Each board is connected to the relevant (up to twelve) CMDX101z

– Rack alarm interface (**RAIU1000**), small height, in slots 39 or 22of the master and the expansion shelves (one board per each shelf); recommended slot is 39

– HouseKeeping (**HSKU1000**), small height, in slots 22 or 39; recommended slot is 22 (optional board)

– Power Supply (**PSUP1000**), small height, in slots 21 and 40 of each shelf

– Fans (**FANS1000**), in slot 41, at the bottom of each shelf

– Line amplifier (**LOFA11y0**), medium height, in up to four slots among 3 and 18 of the master shelf. Optional board, it is able to amplify the line/aggregate signal (all the extended C–band)

– Optical supervisory channel (**OSCU1010**), medium height, in one slot among 3 and 18 of the master shelf. Optional board carrying the 2M supervisory channel on a supplementary wavelength at 1510 nm

– Automatic level control (**ALCT1010**), medium height, typically in up to 1 (LT) or 2 (OADM/B–t–B) slots among 3 and 18 of the master shelf. It is able to maintain a constant optical power on each sub–band of the Extended C Band. See Table 11. on page 101 for the location constraints of this board

The eXTended ID unit (**XTID1000**) give to ESCT1000 the equipment type and shelf identification information. There is one XTID1000 unit per shelf, located in the bottom of the 1626 LM shelf (behind the FANS1000).

Mandatory boards and relevant slots:

In the following are listed the mandatory boards:

– ESCT1000, plugged in Master and expansion shelves
– PSUP1000, plugged in Master and expansion shelves
– FANS1000, plugged in Master and expansion shelves
– RAIU1000, plugged in Master and expansion shelves
– ALCT1010, plugged in Master shelf.
– XTID1000, plugged in Master and expansion shelves

2.2.2.1 1626 LM main and expansion shelves (recommended) configurations

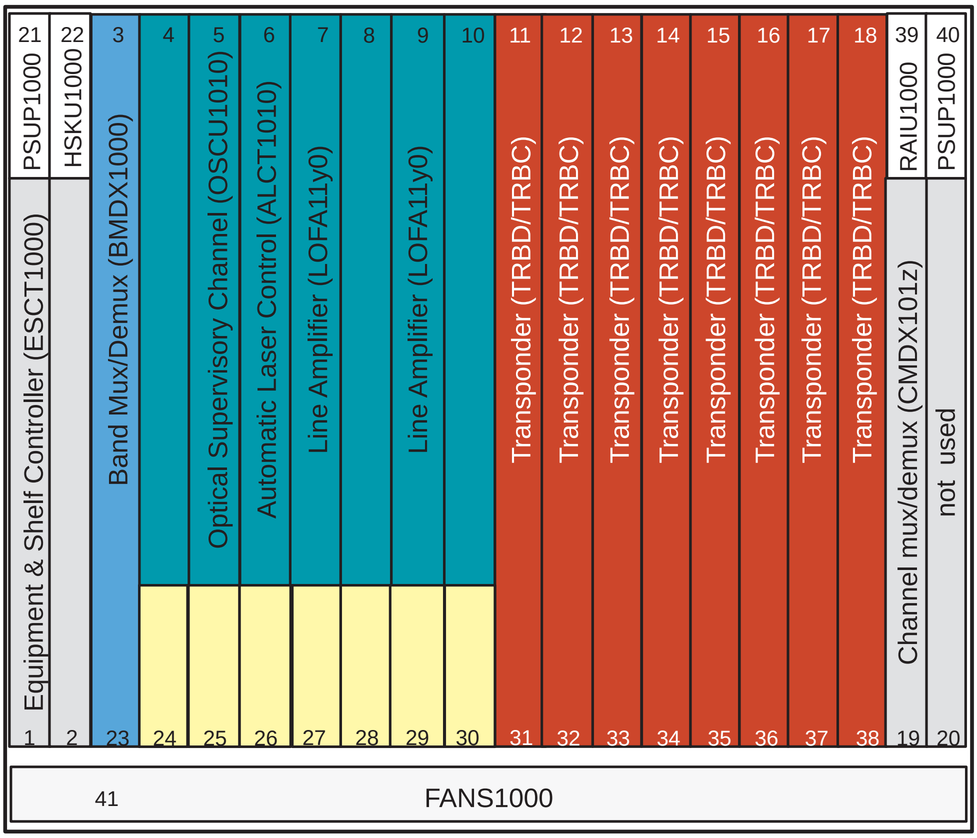


Figure 40. Example of master shelf configuration in Line Terminal application

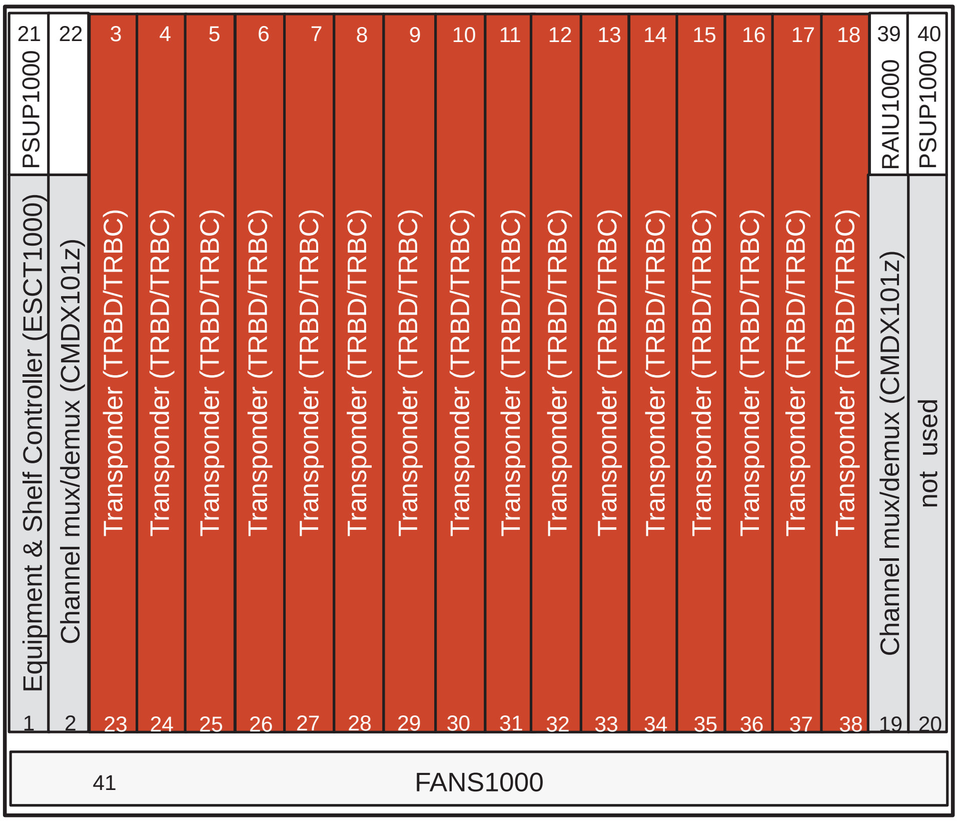


Figure 41. Example of a slave/transponder shelf configuration

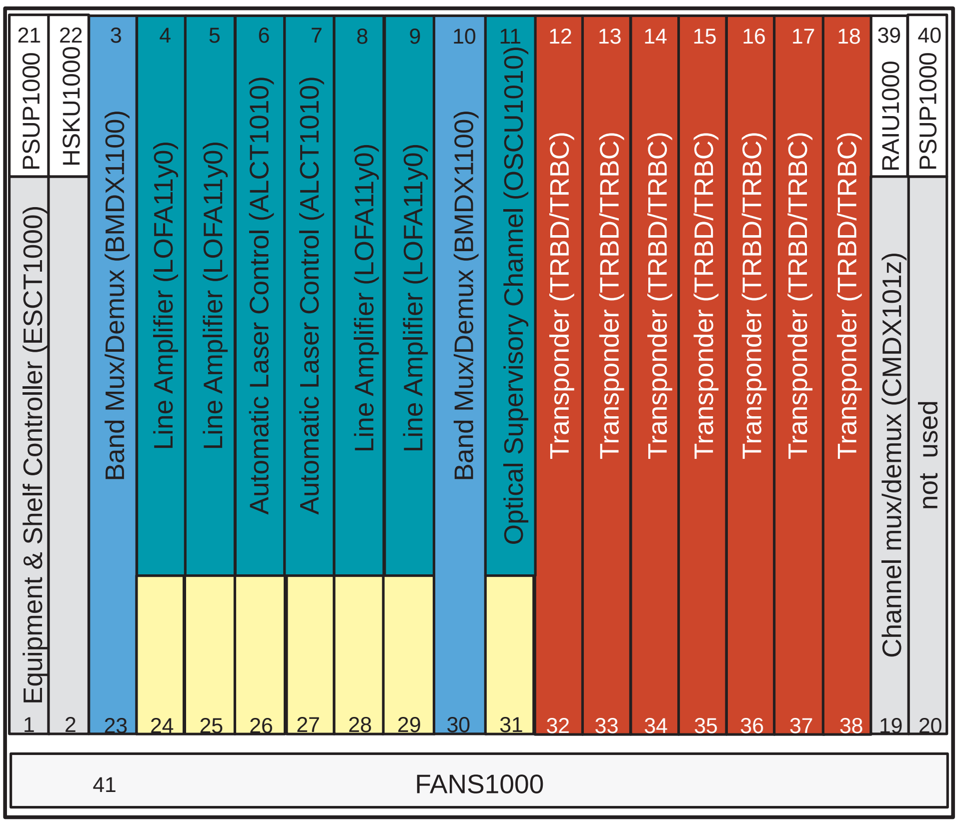


Figure 42. Example of master shelf in OADM repeater configuration (+20 dBm max)

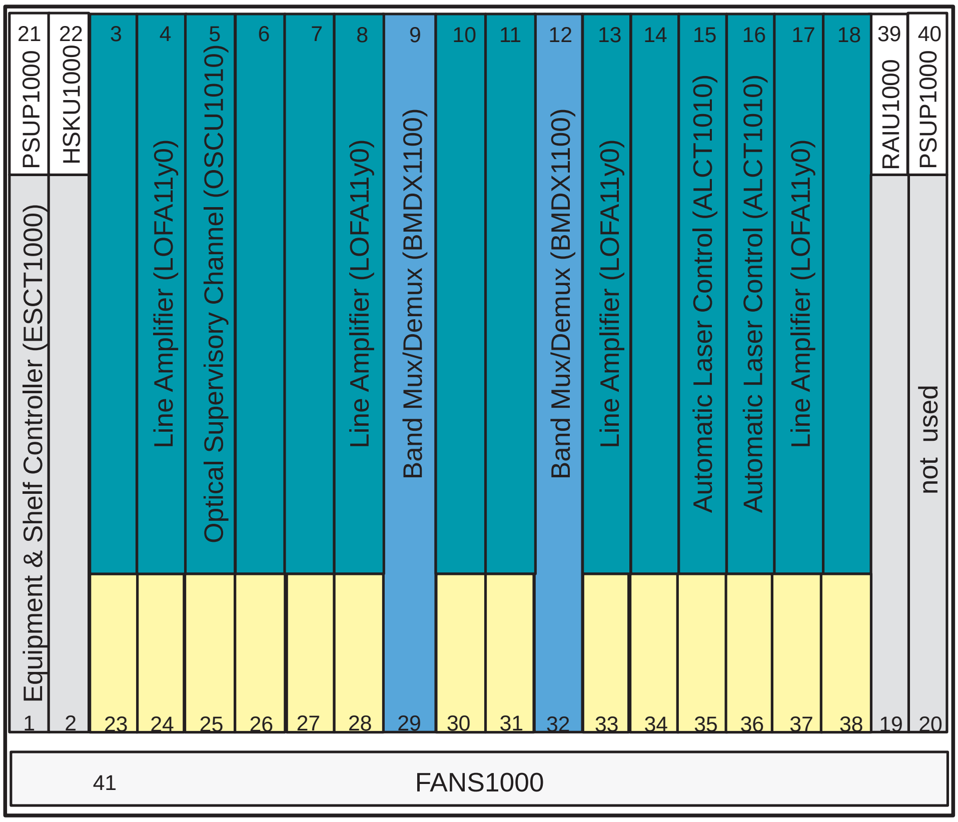


Figure 43. Example of master shelf in OADM repeater configuration (possible upgrade to 23 dBm)

2.2.3 1626 LM Part list

In Table 9. on page 87 of the following paragraph are listed, named and coded the items and units making up the Equipment Shelf (see paragraph 2.2.3.1 on page 87).

Furthermore, for any item the position and the maximum quantity that can be allocated inside the equipment, are indicated too.

Such table reports the following information :

- Item Name
- The "Acronym" identifying the units
- ANV part numbers (3ALXXXXX XXXX)
- Maximum quantity per each shelf
- Position of the unit inside the equipment. Refer to Figure 39. on page 81 and Figure 40. on page 83 for slot numbering.
- Number of explanatory notes

Table 10. on page 95 reports the explanatory notes.

2.2.3.1 1626 LM shelf and boards designation and reference

Table 9. 1626 LM boards and units list

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
MECHANICAL STRUCTURE					
OPTINEX RACK with TRU		3AN 44815 AA—	–	—	
OPTINEX RACK with TRU&door		3AL 37952 AA—	–	—	
1626 LM SHELF		3AL 94511 AA—	–	—	1
21” D.C.U. assembled support		3AN 44747 AC—	–	—	
AIR DEFLECTOR ETSI		3AL 51293 AC—	–	—	
Board Mechanical adapter 20mm/20mm		3AL 94814 AA—	–	—	2
TRIBUTARIES					
TRBD1110 – FULL C–band VLH 10GB TRiButary Direct transponder	TRBD1110	3AL 94207 AA—	16	3 ÷ 18	3
TRBD1011–CH195.9/CH195.85 B1 LH 10GB TRiButary Direct transponder	TRBD1011	3AL 94219 AA—	16	3 ÷ 18	4
TRBD1011–CH195.8/CH195.75 B1 LH 10GB TRiButary Direct transponder		3AL 94219 AC—			
TRBD1011–CH195.7/CH195.65 B1 LH 10GB TRiButary Direct transponder		3AL 94219 AE—			
TRBD1011–CH195.6/CH195.55 B1 LH 10GB TRiButary Direct transponder		3AL 94219 AG—			
TRBD1011–CH195.5/CH195.45 B2 LH 10GB TRiButary Direct transponder		3AL 94219 AL—			
TRBD1011–CH195.4/CH195.35 B2 LH 10GB TRiButary Direct transponder		3AL 94219 AN—			
TRBD1011–CH195.3/CH195.25 B2 LH 10GB TRiButary Direct transponder		3AL 94219 AQ—			
TRBD1011–CH195.2/CH195.15 B2 LH 10GB TRiButary Direct transponder		3AL 94219 AS—			
TRBD1011–CH195.1/CH195.05 B3 LH 10GB TRiButary Direct transponder		3AL 94219 BA—			
TRBD1011–CH195.0/CH194.95 B3 LH 10GB TRiButary Direct transponder		3AL 94219 BC—			
TRBD1011–CH194.9/CH194.85 B3 LH 10GB TRiButary Direct transponder		3AL 94219 BE—			
TRBD1011–CH194.8/CH194.75 B3 LH 10GB TRiButary Direct transponder		3AL 94219 BG—			

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
TRBD1011–CH194.7/CH194.65 B4 LH 10GB TRiButary Direct transponder	TRBD1011	3AL 94219 BL—	16	3 ÷ 18	4
TRBD1011–CH194.6/CH194.55 B4 LH 10GB TRiButary Direct transponder		3AL 94219 BN—			
TRBD1011–CH194.5/CH194.45 B4 LH 10GB TRiButary Direct transponder		3AL 94219 BQ—			
TRBD1011–CH194.4/CH194.35 B4 LH 10GB TRiButary Direct transponder		3AL 94219 BS—			
TRBD1011–CH194.3/CH194.25 B5 LH 10GB TRiButary Direct transponder		3AL 94219 CA—			
TRBD1011–CH194.2/CH194.15 B5 LH 10GB TRiButary Direct transponder		3AL 94219 CC—			
TRBD1011–CH194.1/CH194.05 B5 LH 10GB TRiButary Direct transponder		3AL 94219 CE—			
TRBD1011–CH194.0/CH193.95 B5 LH 10GB TRiButary Direct transponder		3AL 94219 CG—			
TRBD1011–CH193.9/CH193.85 B6 LH 10GB TRiButary Direct transponder		3AL 94219 CL—			
TRBD1011–CH193.8/CH193.75 B6 LH 10GB TRiButary Direct transponder		3AL 94219 CN—			
TRBD1011–CH193.7/CH193.65 B6 LH 10GB TRiButary Direct transponder		3AL 94219 CQ—			
TRBD1011–CH193.6/CH193.55 B6 LH 10GB TRiButary Direct transponder		3AL 94219 CS—			
TRBD1011–CH193.5/CH193.45 B7 LH 10GB TRiButary Direct transponder		3AL 94219 DA—			
TRBD1011–CH193.4/CH193.35 B7 LH 10GB TRiButary Direct transponder		3AL 94219 DC—			
TRBD1011–CH193.3/CH193.25 B7 LH 10GB TRiButary Direct transponder		3AL 94219 DE—			
TRBD1011–CH193.2/CH193.15 B7 LH 10GB TRiButary Direct transponder		3AL 94219 DG—			
TRBD1011–CH193.1/CH193.05 B8 LH 10GB TRiButary Direct transponder		3AL 94219 DL—			
TRBD1011–CH193.0/CH192.95 B8 LH 10GB TRiButary Direct transponder		3AL 94219 DN—			
TRBD1011–CH192.9/CH192.85 B8 LH 10GB TRiButary Direct transponder		3AL 94219 DQ—			
TRBD1011–CH192.8/CH192.75 B8 LH 10GB TRiButary Direct transponder		3AL 94219 DS—			

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
TRBD1011–CH192.7/CH192.65 B9 LH 10GB TRiButary Direct transponder	TRBD1011	3AL 94219 EA––	16	3 ÷ 18	4
TRBD1011–CH192.6/CH192.55 B9 LH 10GB TRiButary Direct transponder		3AL 94219 EC––			
TRBD1011–CH192.5/CH192.45 B9 LH 10GB TRiButary Direct transponder		3AL 94219 EE––			
TRBD1011–CH192.4/CH192.35 B9 LH 10GB TRiButary Direct transponder		3AL 94219 EG––			
TRBD1011–CH192.3/CH192.25 B10 LH 10GB TRiButary Direct transponder		3AL 94219 EL––			
TRBD1011–CH192.2/CH192.15 B10 LH 10GB TRiButary Direct transponder		3AL 94219 EN––			
TRBD1011–CH192.1/CH192.05 B10 LH 10GB TRiButary Direct transponder		3AL 94219 EQ––			
TRBD1011–CH192.0/CH191.95 B10 LH 10GB TRiButary Direct transponder		3AL 94219 ES––			
TRBD1011–CH191.9/CH191.85 B11 LH 10GB TRiButary Direct transponder		3AL 94219 FA––			
TRBD1011–CH191.8/CH191.75 B11 LH 10GB TRiButary Direct transponder		3AL 94219 FC––			
TRBD1011–CH191.7/CH191.65 B11 LH 10GB TRiButary Direct transponder		3AL 94219 FE––			
TRBD1011–CH191.6/CH191.55 B11 LH 10GB TRiButary Direct transponder		3AL 94219 FG––			
TRBD1011–CH191.5/CH191.45 B12 LH 10GB TRiButary Direct transponder		3AL 94219 FL––			
TRBD1011–CH191.4/CH191.35 B12 LH 10GB TRiButary Direct transponder		3AL 94219 FN––			
TRBD1011–CH191.3/CH191.25 B12 LH 10GB TRiButary Direct transponder		3AL 94219 FQ––			
TRBD1011–CH191.2/CH191.15 B12 LH 10GB TRiButary Direct transponder		3AL 94219 FS––			

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
TRBD1111 – FULL C–band VLH 10GB TRiButary Direct transponder	TRBD1111	3AL 94207 AB—	16	3 ÷ 18	5
TRBD1111–CH195.75/CH195.9 B1 VLH 10GB TRiButary Direct transponder	TRBD1111	3AL 94207 BA—	16	3 ÷ 18	
TRBD1111–CH195.35/CH195.7 B1/B2 VLH 10GB TRiButary Direct transponder		3AL 94207 BB—			
TRBD1111–CH194.95/CH195.3 B2/B3 VLH 10GB TRiButary Direct transponder		3AL 94207 BC—			
TRBD1111–CH194.55/CH194.9 B3/B4 VLH 10GB TRiButary Direct transponder		3AL 94207 BD—			
TRBD1111–CH194.15/CH194.5 B4/B5 VLH 10GB TRiButary Direct transponder		3AL 94207 BE—			
TRBD1111–CH193.75/CH194.1 B5/B6 VLH 10GB TRiButary Direct transponder		3AL 94207 BF—			
TRBD1111–CH193.35/CH193.7 B6/B7 VLH 10GB TRiButary Direct transponder		3AL 94207 BG—			
TRBD1111–CH192.95/CH193.3 B7/B8 VLH 10GB TRiButary Direct transponder		3AL 94207 BH—			
TRBD1111–CH192.55/CH192.9 B8/B9 VLH 10GB TRiButary Direct transponder		3AL 94207 BJ—			
TRBD1111–CH192.15/CH192.5 B9/B10 VLH 10GB TRiButary Direct transponder		3AL 94207 BK—			
TRBD1111–CH 191.75/CH192.1 B10/B11 VLH 10GB TRiButary Direct transponder		3AL 94207 BL—			
TRBD1111–CH191.35/CH191.7 B11/B12 VLH 10GB TRiButary Direct transponder		3AL 94207 BM—			
TRBD1111–CH191.15/CH191.3 B12 VLH 10GB TRiButary Direct transponder		3AL 94207 BN—			

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
TRBD1121 – FULL C–band VLH 10GB TRiButary Direct transponder	TRBD1121	3AL 94207 AC—	16	3 ÷ 18	6
TRBD1121–CH195.75/CH195.9 B1 VLH 10GB TRiButary Direct transponder	TRBD1121	3AL 94207 CA—	16	3 ÷ 18	
TRBD1121–CH195.35/CH195.7 B1/B2 VLH 10GB TRiButary Direct transponder		3AL 94207 CB—			
TRBD1121–CH194.95/CH195.3 B2/B3 VLH 10GB TRiButary Direct transponder		3AL 94207 CC—			
TRBD1121–CH194.55/CH194.9 B3/B4 VLH 10GB TRiButary Direct transponder		3AL 94207 CD—			
TRBD1121–CH194.15/CH194.5 B4/B5 VLH 10GB TRiButary Direct transponder		3AL 94207 CE—			
TRBD1121–CH193.75/CH194.1 B5/B6 VLH 10GB TRiButary Direct transponder		3AL 94207 CF—			
TRBD1121–CH193.35/CH193.7 B6/B7 VLH 10GB TRiButary Direct transponder		3AL 94207 CG—			
TRBD1121–CH192.95/CH193.3 B7/B8 VLH 10GB TRiButary Direct transponder		3AL 94207 CH—			
TRBD1121–CH192.55/CH192.9 B8/B9 VLH 10GB TRiButary Direct transponder		3AL 94207 CJ—			
TRBD1121–CH192.15/CH192.5 B9/B10 VLH 10GB TRiButary Direct transponder		3AL 94207 CK—			
TRBD1121–CH 191.75/CH192.1 B10/B11 VLH 10GB TRiButary Direct transponder		3AL 94207 CL—			
TRBD1121–CH191.35/CH191.7 B11/B12 VLH 10GB TRiButary Direct transponder		3AL 94207 CM—			
TRBD1121–CH191.15/CH191.3 B12 VLH 10GB TRiButary Direct transponder		3AL 94207 CN—			
TRBD1131 – FULL C–band VLH 10GB Ethernet TRiButary Direct transponder	TRBD1131	3AL 94207 AE—	16	3 ÷ 18	7
TRiButary Concentrator TRBC1111 – full C band tunable	TRBC1111	3AL 94452 AA—	16	3 ÷ 18	8
TRIBUTARY SUBSYSTEM					
OPTO TRX SFP S–16.1 PLUGIN	SFP S–16.1	1AB 19637 0001	64		9

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
MULTIPLEXERS					
CMDX 1010 1:8 B1 CH MUX/DEMUX	CMDX1010	3AL 95507 AA—	2	2 ÷ 19	10
CMDX 1010 1:8 B2 CH MUX/DEMUX		3AL 95507 AB—			
CMDX 1010 1:8 B3 CH MUX/DEMUX		3AL 95507 AC—			
CMDX 1010 1:8 B4 CH MUX/DEMUX		3AL 95507 AD—			
CMDX 1010 1:8 B5 CH MUX/DEMUX		3AL 95507 AE—			
CMDX 1010 1:8 B6 CH MUX/DEMUX		3AL 95507 AF—			
CMDX 1010 1:8 B7 CH MUX/DEMUX		3AL 95507 AG—			
CMDX 1010 1:8 B8 CH MUX/DEMUX		3AL 95507 AH—			
CMDX 1010 1:8 B9 CH MUX/DEMUX		3AL 95507 AJ—			
CMDX 1010 1:8 B10 CH MUX/DEMUX		3AL 95507 AK—			
CMDX 1010 1:8 B11 CH MUX/DEMUX		3AL 95507 AL—			
CMDX 1010 1:8 B12 CH MUX/DEMUX		3AL 95507 AM—			
BMDX1000 1:12 OLTE Band Mux/Demux	BMDX1000	3AL 95504 AA—	2	3 ÷ 18	11
BMDX1100 1:12 OADM Band Mux/Demux	BMDX1100	3AL 95504 AB—	2	3 ÷ 18	12
ALCT1010 B2 1534.65NM	ALCT1010	3AL 94639 AB—	–	3 ÷ 18	13
ALCT1010 B3 1537.80NM		3AL 94639 AC—			
ALCT1010 B4 1540.95NM		3AL 94639 AD—			
ALCT1010 B5 1544.13NM		3AL 94639 AE—			
ALCT1010 B6 1547.32NM		3AL 94639 AF—			
ALCT1010 B7 1550.52NM		3AL 94639 AG—			
ALCT1010 B8 1553.74NM		3AL 94639 AH—			
ALCT1010 B9 1556.96NM		3AL 94639 AL—			
ALCT1010 B10 1560.20NM		3AL 94639 AM—			
ALCT1010 B11 1563.46NM		3AL 94639 AN—			
ALCT1010 B12 1566.73NM		3AL 94639 AP—			
OPTICAL AMPLIFIERS					
LOFA1110 – OPTICAL AMPLIFIER 22/9	LOFA1110	3AL 94211 AA—	4	3 ÷ 18	14
LOFA1120 – OPTICAL AMPLIFIER 22/9	LOFA1120	3AL 94211 AB—			
CONTROLLER					
Equipment and Shelf Controller	ESCT1000	3AL 94304 AA—	1	1	15
256 MB Flash card (–20 / +85°C)	MEM–DEV	1AB 17634 0002	1		16
OSCU1010–Optical Supervisory Channel	OSCU1010	3AL 94249 AA—	1	3 ÷ 18	17
Rack Alarm Interface Unit	RAIU1000	3AL 94305 AA—	1	22, 39	18
Housekeeping unit	HSKU1000	3AL 94253 AA—	1	22, 39	19
POWER SUPPLY					
Power Supply Card	PSUP1000	3AL 94247 AA—	2	21, 40	20
FANS					
FANS	FANS1000	3AL 94251 AA—	1	41	21
FAN unit protection		3AL 94613 AA—	1	41	

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
EQUIPMENT ACCESSORIES					
20 Ampere 72Vcc Circuit Breaker		1AB 16271 0007	2		22
BLNK 3100 25MM FULL DUMMY		3AL 94480 AA—	15		23
BLNK 2000 20MM MEDIUM DUMMY		3AL 94476 AA—	15		
BLNK 1000 20MM SMALL DUMMY upper		3AL 94478 AA—	1		
BLNK 3100 25MM FULL DUMMY ETSI		3AL 94881 AA—	15		
BLNK 2000 20MM MEDIUM DUMMY ETSI		3AL 94882 AA—	15		
BLNK 1000 20MM SMALL DUMMY lower		3AL 94883 AA—	1		
1626 LM Optinex installation kit		3AL 94773 AA—	1		24
BNC LAN cable 50 Ω, for intra shelf conn.		3AL 94752 AA—	1		25
Coax cable 50 Ω for intra shelf connection		1AC 00025 0005	1		26
BNC coax connector, 50 Ω male		1AB 00642 0016			
4–shielded pair cable (intra shelf conn.)		1AC 01676 0003	1		27
RJ45 connector		1AB 07461 0008			
13–pair twisted shielded cable (HSKU)		1AC 01491 0013	1		28
SUB–D 25–pin female connector		1AB 00315 0334			
HSKU cable		3AL 94768 AA—	1		29
Chain alarm cable (RAIU connection)		3AL 94740 AA—	1		30
OFFICE SIDE ACCESSORIES					
CMDX cabling kit		3AL 94756 AA—	2		31
BMDX cabling kit		3AL 94757 AA—	1		32
OADM cabling kit +20 dBm		3AL 94758 AA—	1		33
OADM cabling kit		contact Alcatel	1		34
Line OADM kit		contact Alcatel	1		35
Line Terminal kit		contact Alcatel	1		36
Inter–shelf cabling kit (2nd SHELF)		3AL 94759 AA—	1		37
Inter–shelf cabling kit (3rd SHELF)		3AL 94759 BA—	1		38
Inter–shelf cabling kit (4th SHELF)		3AL 94759 CA—	1		39

NAME	ACRONYM	ANV Part Number	Max Q.ty/ shelf	SLOT	Notes
INSTALLATION MATERIALS					
OPTO ATTEN MU/PC 1dB plug type		1AB 20480 0001	2		
OPTO ATTEN MU/PC 2dB plug type		1AB 20480 0002	2		
OPTO ATTEN MU/PC 3dB plug type		1AB 20480 0003	2		
OPTO ATTEN MU/PC 4dB plug type		1AB 20480 0004	2		
OPTO ATTEN MU/PC 5dB plug type		1AB 20480 0005	2		
OPTO ATTEN MU/PC 6dB plug type		1AB 20480 0006	2		
OPTO ATTEN MU/PC 7dB plug type		1AB 20480 0007	2		
OPTO ATTEN MU/PC 8dB plug type		1AB 20480 0008	2		
OPTO ATTEN MU/PC 9dB plug type		1AB 20480 0009	2		
OPTO ATTEN MU/PC 10dB plug type		1AB 20480 0010	2		
OPTO ATTEN MU/PC 11dB plug type		1AB 20480 0011	2		
OPTO ATTEN MU/PC 12dB plug type		1AB 20480 0012	2		
OPTO ATTEN MU/PC 13dB plug type		1AB 20480 0013	2		
OPTO ATTEN MU/PC 14dB plug type		1AB 20480 0014	2		
OPTO ATTEN MU/PC 15dB plug type		1AB 20480 0015	2		
OPTO ATTEN MU/PC 20dB plug type		1AB 20480 0016	2		
REMOVAL TOOL MU PLUG_IN ATTEN.		1AD 03860 0002	1		40
KIT–CABLE DUCT		3AL 94888 AA—	1		41
OPTICAL COMPENSATION DEVICE					
Dispersion Compensation Module–5 Km	DCM–5	1AB 15169 0013	2		42
Dispersion Compensation Module–10 Km	DCM–10	1AB 15169 0007			
Dispersion Compensation Module–15 Km	DCM–15	1AB 15169 0014			
Dispersion Compensation Module–20 Km	DCM–20	1AB 15169 0008			
Dispersion Compensation Module–30 Km	DCM–30	1AB 15169 0009			
Dispersion Compensation Module–40 Km	DCM–40	1AB 15169 0010			
Dispersion Compensation Module–60 Km	DCM–60	1AB 15169 0011			
Dispersion Compensation Module–80 Km	DCM–80	1AB 15169 0012			
100 Km negative compensation	DCM–100	1AB 15169 0038			
DCM E–LEAF 10 KM “C” BAND	DCM–10	1AB 194510007			
DCM E–LEAF 25 KM “C” BAND	DCM–25	1AB 194510001			
DCM E–LEAF 50 KM “C” BAND	DCM–50	1AB 194510002			
DCM E–LEAF 75 KM “C” BAND	DCM–75	1AB 194510003			
DCM E–LEAF 100 KM “C” BAND	DCM–100	1AB 194510004			
DCM E–LEAF 125 KM “C” BAND	DCM–125	1AB 194510005			
DCM E–LEAF 150 KM “C” BAND	DCM–150	1AB 194510006			

end of table

Table 10. 1626 LM explanatory notes

Note	Explanation
1	It is the equipment shelf, including the back panel and the XTID1000 unit (containing equipment mandatory information as equipment type and shelf_ID)
2	Full heigth reductor/adapter allowing to install a 20mm medium height board (LOFA, OSCU, ALCT) in slots 3 to 18 and a 20mm small height board in slots 23 to 38
3	TRBD1110 is a bidirectional 3R, G.709 transponder supporting a 9.9532 B&W optical interface and a 10.709Gbps coloured WDM optical interface (NRZ), tunable over the whole (extended) C–band. It provides UNI (NNI in future rel., with OTU–2 10.709Gbps B&W interface). The WDM emitter consists of a $LiNb0_3$ Mach–Zenhder modulator and a laser
4	TRBD1011 is a bidirectional 3R, G.709 transponder supporting a B&W optical interface and a 10.709Gbps coloured WDM optical interface (NRZ), tunable over 2 frequencies, 50GHz spaced, in (extended) C–band. It provides UNI at 9.9532Gbps (NNI in future rel., with OTU–2 10.709Gbps B&W interface). The WDM emitter consists of an Integrated Laser Modulator (ILM). Up tp 16 TRBD1011, whatever their frequency, can be put in a shelf. Furthermore, in some OADM configuration, we may have 4 units of the same code in one shelf (2 freq. 50GHz spaced per direction)
5	TRBD1111 is a bidirectional 3R, G.709 transponder supporting a VSR (short reach) B&W optical interface and a 10.709Gbps coloured WDM optical interface (NRZ), tunable, according to the board type (see “name” column) over 8 frequencies or the full extended C–band, with 50 GHz spacing. It provides UNI at 9.9532Gbps (NNI in future rel., with OTU–2 10.709Gbps B&W interface). The WDM emitter consists of a $LiNb0_3$ Mach–Zenhder modulator and a laser. Up tp 16 TRBD1111, whatever their frequency, can be put in a shelf. Furthermore, in some OADM configurations, 16 units of the same code may be provided in one shelf (full band/8–frequency tunability)
6	TRBD1121 is the same as TRBD1111 (see 5). The only difference is the B&W interface: it is a S–64.2b (intermediate reach) one.
7	TRBD1131 is the same as TRBD1111, FULL C–BAND tuneable type (see 5). The only difference is that it is dedicated to 10 GBEthernet (no VSR), thus providing a 10GBASE–LR (10 Km reach, 1310 nm) B&W interface at 10.31 Gbps (UNI only). WDM bit rate is 11.09 Gbps.
8	TRBC1111 is a bidirectional 3R, G.709 transponder concentrating four B&W STM–16/OC–48 optical signals (TDM concentrator) in a 10.709Gbps coloured WDM optical interface (NRZ), tunable over the whole (extended) C–band. It provides UNI at 2.488Gbps (NNI in future rel., with OTU–1 2.666 Gbps B&W interface). The WDM emitter consists of a $LiNb0_3$ Mach–Zenhder modulator and a laser
9	STM–16 SFP (Small Formfactor Pluggable) optical module, equipped on TRBC client side. Up to 4 modules can be plugged on each TRBC
10	Channel (8:1) mux / (1:8) demux @50GHz, for terrestrial and submarine links. It multiplexes/demultiplexes eight coloured optical signals to/from a single port, connected to the BMDX
11	Band (12:1) mux / (1:12) demux, used in line terminal and back–to–back configurations, supporting up to 8 wavelengths per band. It multiplexes the up to twelve bands coming from the CMDXs into the aggregate signal (up to 96 chs) to be sent to the WDM line and demultiplexes the aggregate signal into twelve bands forwarded to the CMDXs. In back–to–back configuration, all the 12 bands are managed
12	Band OADM. It is a modified band (12:1) mux / (1:12) demux (see 11) for OADM application, with up to 100% Add/Drop capacity in full symmetric configuration. It supports up to 7 wavelengths per band
13	Automatic Laser ConTrol used to facilitate the loading of the system with a few number of modulated channels or to compensate for the loss of some modulated channels. Typically one board per Line Terminal and two boards per OADM/back–to–back are used. According to the link design, a higher number can be needed
14	Double–stage, erbium doped fiber amplifiers able to amplify all the 96 channels in extended C–band
15	It includes both the equipment and shelf controller functionalities. It has to be fitted in expansion shelves, too; in this case it performs only the shelf controller function

Note	Explanation
16	The flash card contains the equipment data base. It must be equipped on the ESCT1000 unit of the master shelf
17	The Optical Supervisory Channel Unit carries supervision information from/to NEs by means of an additional 1510 nm wavelength
18	It monitors the racks alarms to light ON or OFF the lamps of the TRU. It is equipped in each shelf to collect information on the alarms raised in the same shelf
19	It provides 8 input accesses and 8 output accesses, managed by CT/1353SH. One HKSU board can be installed in master shelf. One HSkU1000 unit per each NE can be provided
20	PSUP1000 boards work in “1+1” protection and they are both active at the same time, supplying the units in the subrack with nominal 48V or 60V, 3V and 5V
21	Equipped with three fans, the unit is located at the bottom of each 1626 LM shelf, allowing to dissipate the heat and to regulate the board temperature. A FAN UNIT PROTECTION (no–dust filter) has to be put just below the fans
22	To be used for external subrack power protection
23	It is essential to insert the relevant dummy plates on the spaces left by the units not supplied in order to obtain the EMI/EMC performances
24	It includes power supply cables (3AL 94739 AA—), connected to the PSUP units, and the TRU alarm cable (3AL 94742 AA—), connected to the RAIU unit in master shelf
25	Used for intra–shelf (chain) connection (10Base2 – Ethernet)
26	It allows to connects the EC to the NMS, on 10Base2 – Ethernet interface; assembled on field
27	It has to be assembled on field. This cable can be used for – intra–shelf connection with HUB using (10BaseT – Ethernet) – 2 Mbps tributary connection, on TRBD/TRBC front plate
28	To be connected with the 25–pin connector of the HSKU1000 unit, assembled on field
29	To be connected with the 25–pin connector (1AB 00315 0334) of the HSKU1000 unit; used insted of 28 (13–pair twisted shielded cable, 1AC 01491 0013)
30	RAIU cable for chain connection
31	It includes 16 SMF mu/pc jumpers for TRBD/TRBC – CMDX connection (up to 8 TRBD or TRBC per CMDX), in both directions
32	It includes 3 SMF jumpers for BMDX to BOFA connection, BOFA to CMDX connection and CMDX to BMDX connection, for one sub–band (in both directions). BOFA is not used in current rel.
33	It includes 24 SMF MU/PC – MU/PC jumpers for pass–through connections between the two BMDXs, in both directions
34	It includes 22 x SMF MU/PC – MU/PC jumpers for pass–through connections between the two BMDXs, in both directions. The following jumpers (P/N) are provided: 12 x 1AB182400044 and 10 x 1AB182400053
35	It includes 10 x SMF MU/PC – MU/PC jumpers used to connect BMDX/OSCU/ALCT/LOFA1 each other, in OADM configuration. The following jumpers (P/N) are provided: 2 x 1AB182400015; 2 x 1AB182400009; 2 x 1AB182400010; 1 x 1AB182400013; 2 x 1AB182400014; 2 x 1AB182400042; 2 x 1AB182400017
36	It includes 5 x SMF MU/PC – MU/PC jumpers used to connect BMDX/OSCU/ALCT/LOFA1 each other. In Line Terminal configuration. The following jumpers (P/N) are provided: 2 x 1AB182400015; 2 x 1AB182400013; 1 x 1AB182400011
37	It includes 4 x SMF MU/PC – MU/PC jumpers for BMDX – CMDXs (in slave shelf 1) connection
38	It includes 4 x SMF MU/PC – MU/PC jumpers for BMDX – CMDXs (in slave shelf 2) connection
39	It includes 4 x SMF MU/PC – MU/PC jumpers for BMDX – CMDXs (in slave shelf 3) connection
40	Used to remove the opto attenuator plug–in
41	Used for power supply cables installation when they come from the bottom of the rack

Note	Explanation
42	Dispersion Compensating Modules providing chromatic dispersion compensation. They are not located in the 1626 LM shelf, but in other shelves named “21” D.C.U. assembled support” (DCU2 shelf). The number following DCM in the name of the module refers to the length of fiber whose chromatic dispersion it compensates for: DCM10 for SMF compensates for 10 km of SMF whereas DCM10 for E–LEAF compensates for 10 km of E–LEAF. DCMs can be placed in the inter–stage of an optical amplifier. One DCM simultaneously compensates for the chromatic dispersion of all the 1626 LM channels

2.2.4 1626 LM shelf front view

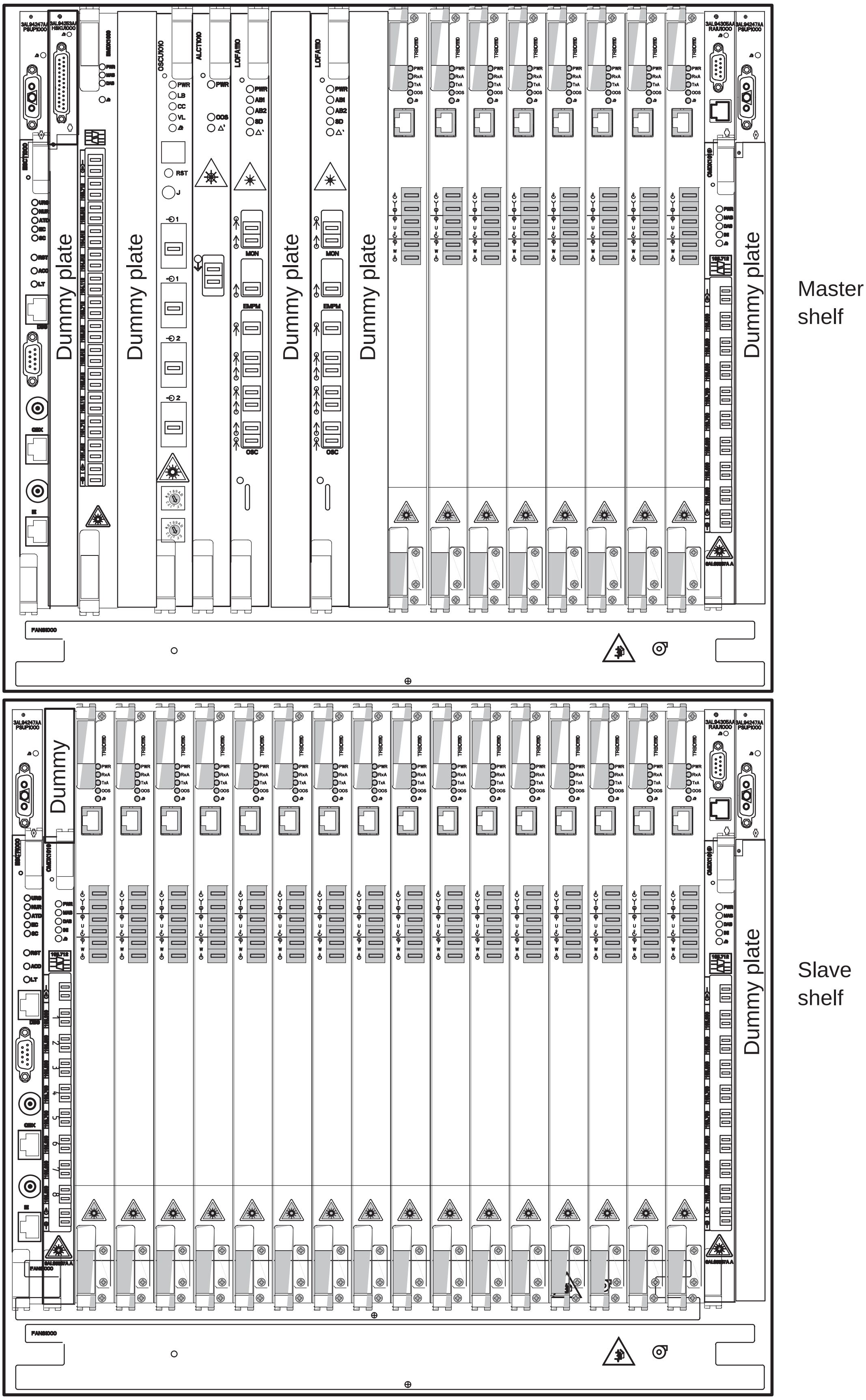


Figure 44. Example of Master and slave shelves front view in Line Terminal configuration

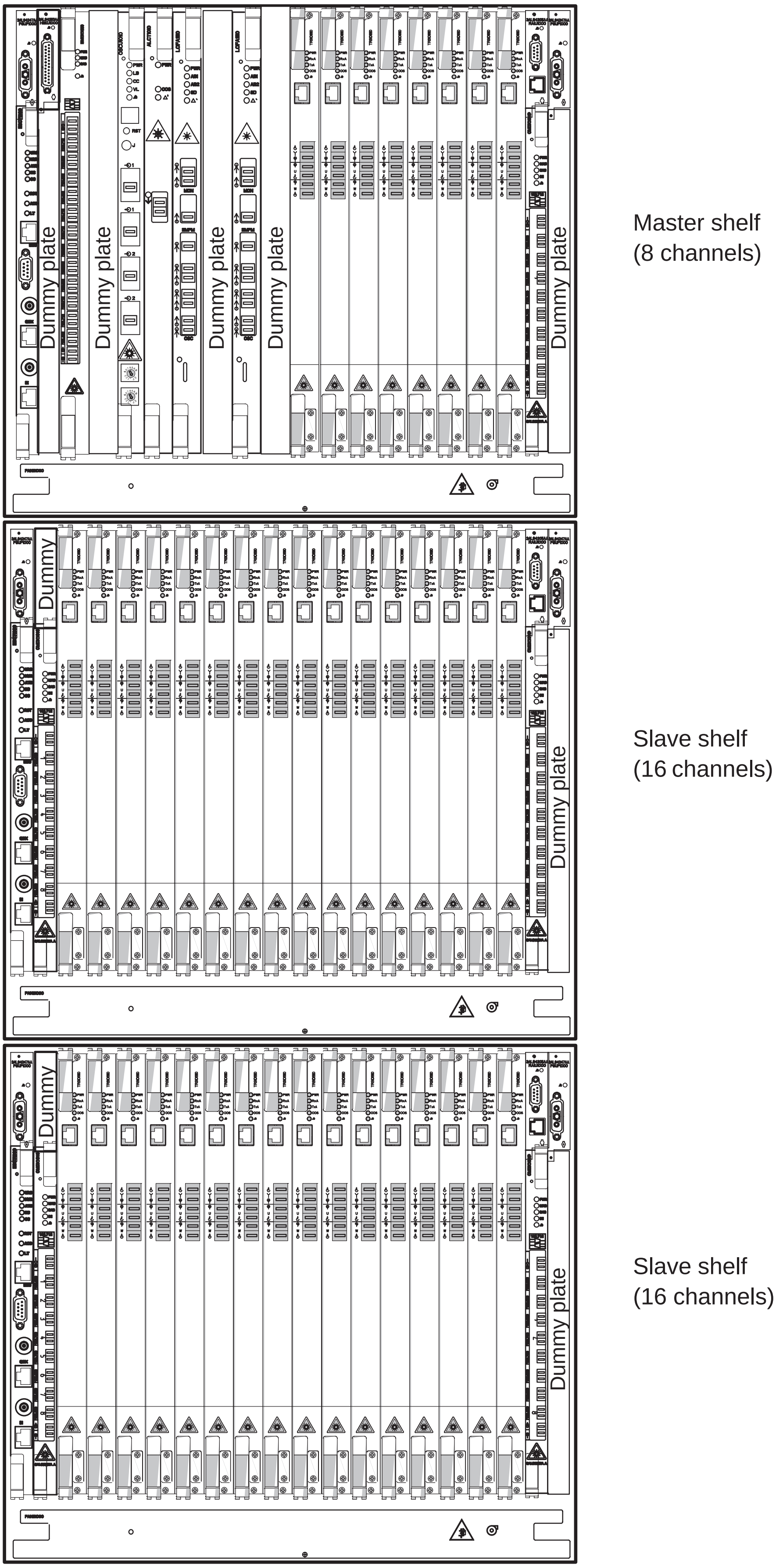
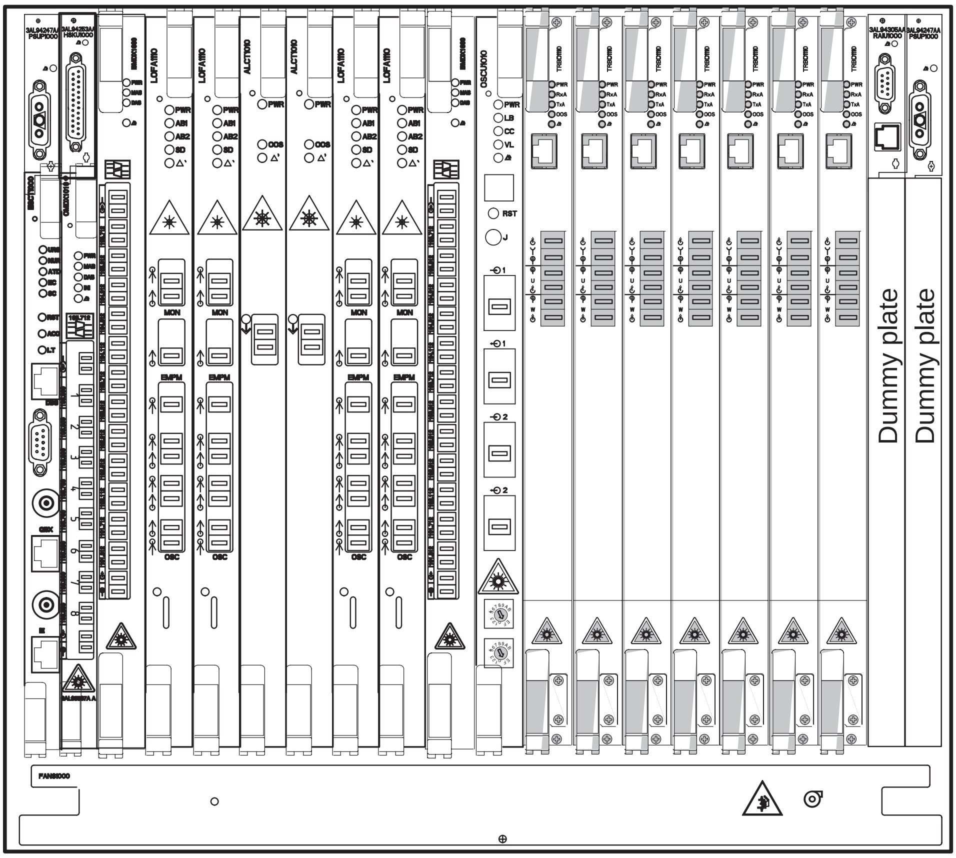
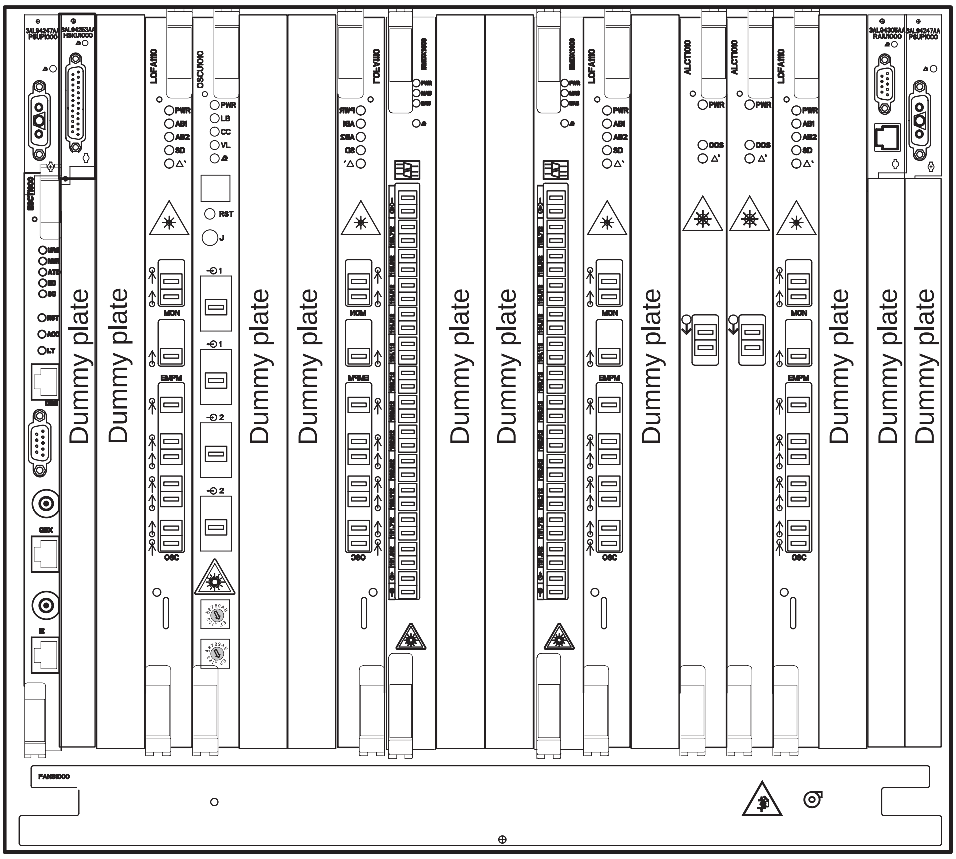


Figure 45. Example of 1626 LM in Line Terminal configuration with 40 channels



Master shelf

Figure 46. Example of Master shelf front view in OADM Repeater configuration (+20 dBm max)



Master shelf

Figure 47. Example of Master shelf in OADM Repeater configuration (upgrade to +23 dBm is possible)

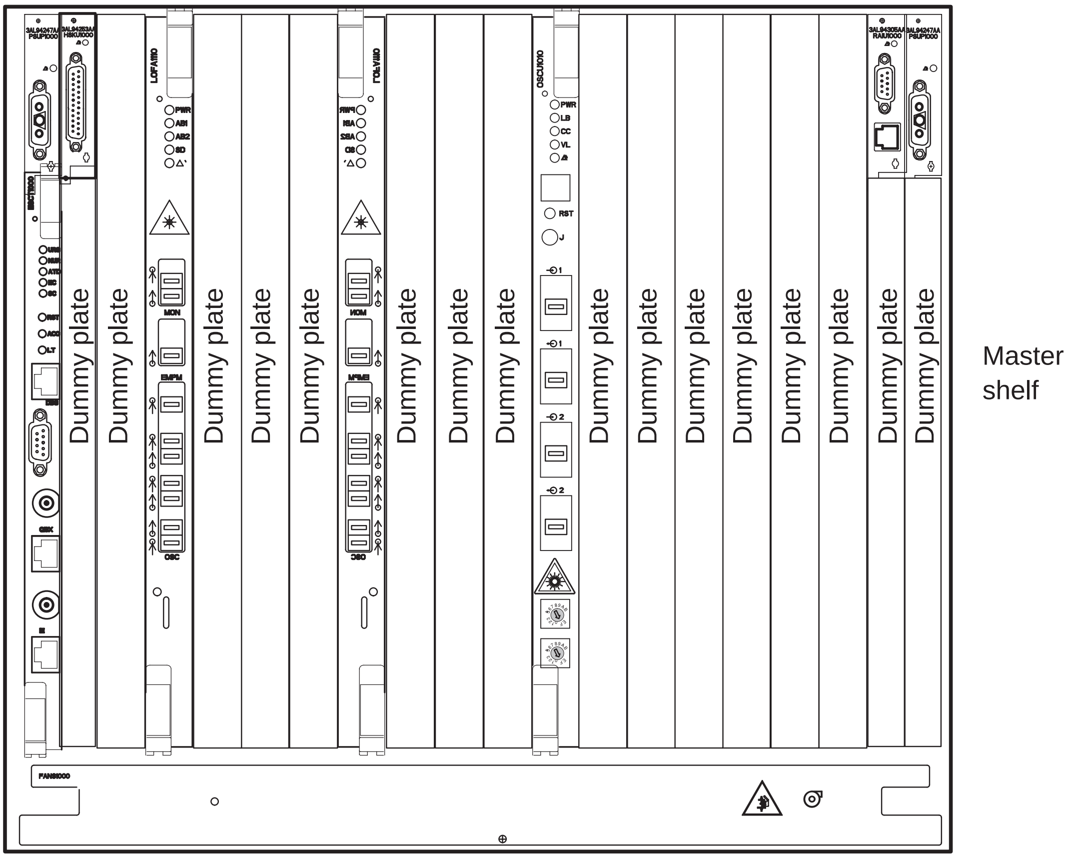


Figure 48. Example of Master shelf front view in Line Repeater configuration

2.2.5 Boards location constraints

Table 11. ALCT location constraints with respect to BMDX (for use in dynamic mode only)

BMDX1x00 location	ALCT1010 location
SLOT 3	SLOT 6
SLOT 4	SLOT 5
SLOT 5	SLOT 4
SLOT 6	SLOT 3
SLOT 7	SLOT 10
SLOT 8	SLOT 9
SLOT 9	SLOT 8
SLOT 10	SLOT 7
SLOT 11	SLOT 14
SLOT 12	SLOT 13
SLOT 13	SLOT 12
SLOT 14	SLOT 11
SLOT 15	SLOT 18
SLOT 16	SLOT 17
SLOT 17	SLOT 16
SLOT 18	SLOT 15

2.3 Equipment connections

The external connections of the 1626 LM may fall into the following categories:

- optical
- management
- maintenance
- power supply
- user interfaces

All the equipment connection are detailed in the Installation Handbook.

Next paragraph 2.4 on page 105 presents the front view of all the cards, where the connection points can be identified.

In the following some general indication and reference to the relevant front view are given.

2.3.1 Optical connections

2.3.1.1 MU/SPC connectors

See Figure 49. The optical connections are made with double MU/SPC connectors on:

- TRBDwxyz boards, both Back & White and WDM coloured interfaces, see Figure 52. on page 106
- TRBC1111 boards, on WDM coloured interfaces, see Figure 53. on page 107
- CMDX1010 boards, see Figure 54. on page 108.
- BMDX1000 and BMDX1100 boards, see Figure 55. on page 109.

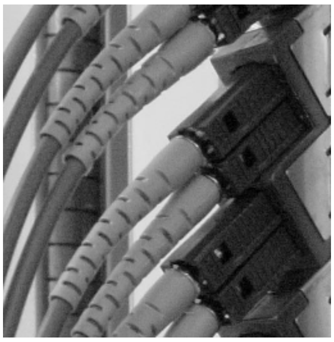


Figure 49. Double MU optical connector

2.3.1.2 LC/SPC connectors

Figure 50. The optical connections are made with LC/SPC connectors on:

– TRBC1111 boards, on Back & White interfaces, see Figure 53. on page 107

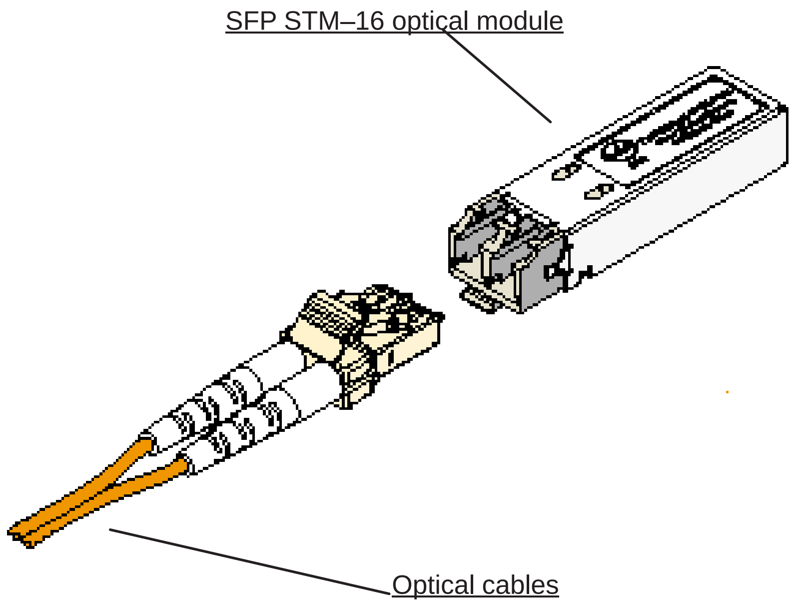


Figure 50. LC/SPC optical connector

2.3.2 Management and maintenance connections

2.3.2.1 NMS Interface

It is the Q3 interface toward the Network Management System (NMS). It is a 10Mbps Ethernet interface provided by a RJ45 (10Base–2 interface) and a BNC (10Base–T interface) connector, located on the ESCT1000 front panel.
See Figure 58. on page 112.

2.3.2.2 Craft Terminal Interface

It is the Q3 interface toward the Craft Terminal. It is a 38.4Kbps serial RS232 interface provided by the 9–pin SUB–D female connector, located on the ESCT1000 front panel.
See Figure 58. on page 112.

2.3.2.3 Inter–shelf link

Inter–shelf link (IS–LINK) allow the communication between the EC and all the SCs of the NE. It is a 10Mbps Ethernet bus, allowing the communication between EC and SCs located in separate shelves (communication between EC and the local SC is performed on a local serial bus named ISSB).
The connections can be performed by means of BNC or RJ45 connectors, located on the ESCT1000 front panel.
Using BNC connectors (10Base–2 interface) each shelf is connected to the adjacent one (bus topology), by means of a T connector.
Using RJ45 connectors (10Base–T interface), each shelf (ESCT1000 board) is connected to an Ethernet hub, located in the master rack.
In master shelf only, the above BNC or RJ45 connector can be connected to the 1353SH.
Figure 51. on page 104 shows the two different topologies.
Figure 58. on page 112 shows the ESCT1000 front panel.

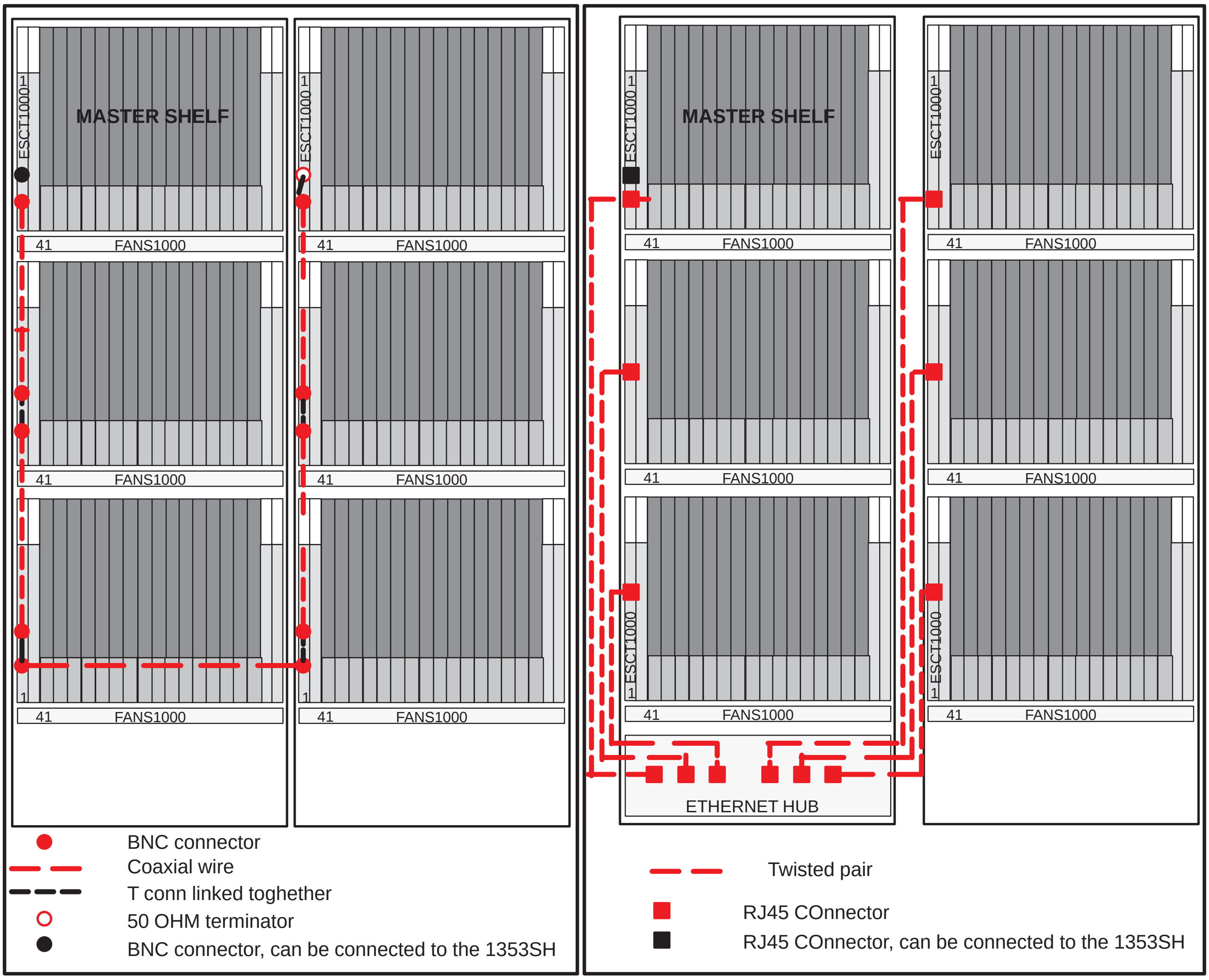


Figure 51. Examples of intra–shelf links (with 10Base–2 and 10Base–T interface)

2.3.2.4 Rack Alarm Interface

Two front panel connectors are available on the RAIU1000 board.
These two interfaces are:

- a 9 pins SUB–D female connector
  - in master shelf it provides the interface with the TRU
  - in slave shelf it can be connected either with the TRU (point–to–point connection) or with the RJ11 connector of another RAIU1000 board, located in the above shelf (intra–shelf or chain connection)
- a RJ11 connector, which allows intra–shelf (chain) connection. It has to be connected with the 9–pin SUB–D connector of the RAIU1000 located in the shelf below.

See Figure 61. on page 115.

2.3.2.5 Housekeeping

The housekeeping alarm signals are available on the front panel connector of the HSKU1000 board. It is a 25 pin SUB–D Female connector.

See Figure 60. on page 114.

2.3.2.6 “DBG” interface connector

It is the interface toward debug tool, available for each EC and SC. It is a 38.4Kbps interface with a 8–pin RJ45 connectors, on the front–panel of the ESCT1000 board (factory tests).
See Figure 58. on page 112.

2.3.3 Power supply connections

Power supply voltage is distributed to the shelves on a 3 pin SUB–D connector, located on the front panel of each PSUP1000.

See Figure 62. on page 116.

2.4 Units front view

The following paragraphs show the units front views and the relevant access points (Leds, switches etc.) together with legenda and meaning.

ACRONYM	SLOTS
TRBD1111	any slots among 3 plus 23 and 18 plus 38
TRBD1011	
TRBD1110	
TRBD1121	
TRBD1131	

Legenda	
Name	**Meaning**
PWR Green /Red led	This led is GREEN when the board is power supplied. This led is RED when one of the internal ±48V power supplies is failed or switched–off (e.g. at unit start–up, unit not configured)
RxA Yellow led	If switched ON it means that at least one of the following alarms occurs: ILOS_WDM, OTU2_LOF_WDM, OTU2_LOM_WDM, GEN_AIS_WDM. If switched OFF none of these alarms are raised.
TxA Yellow led	If switched ON it means that at least one of the following alarms occurs: ILOS_B&W, WOR, OPOR_VOA. If switched OFF none of these alarms are raised.
OOS Yellow led	It may light on in transitory state
Green / Yellow / Red led	The LED is – OFF when the board is plugged but not configured – green when the board is plugged, configured and without failure – red, meaning failure due to hardware failure, power supply failure or failure in communication on the board – yellow when a firmware download is being performed. The board must not be extracted*
RJ45 (G.703)	RJ45 (G.703) connector (not used in current release)
Y	It allows to monitor the received WDM signal (from CMDX)
U	B&W Rx – Reception from User: client input signal (from client)
	B&W Tx – Transmission to User: client output signal (to client)
W	WDM Rx – WDM Reception: WDM input signal (from CMDX)
	WDM Tx – WDM Transmission: WDM output signal (to CMDX)

N.B. * When a board is on firmware download state, the hardware failure led on the front board lights on yellow colour. **Never unplug a board while this LED is yellow. Should this occur, the board will not restart and may have to be returned for factory repair**.

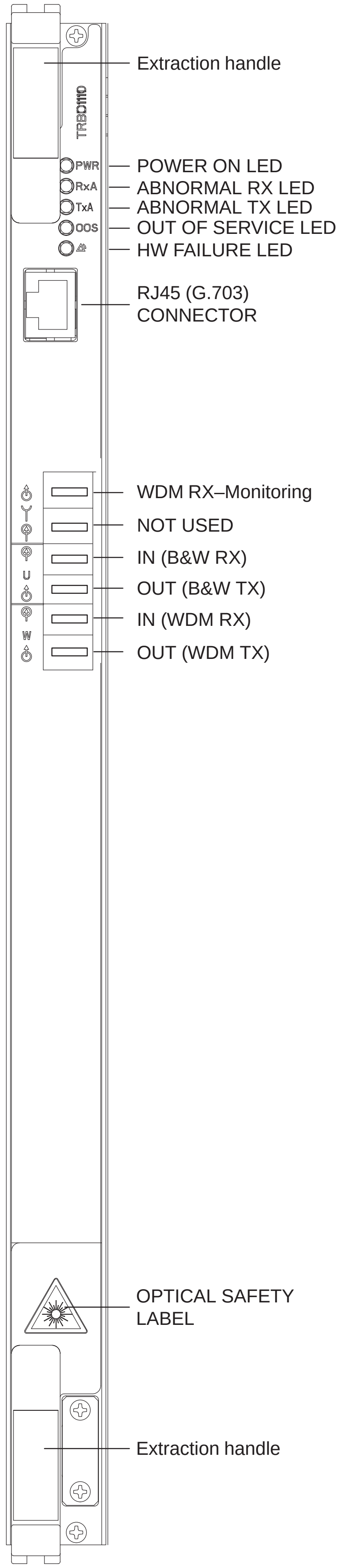


Figure 52. TRBD1xyz board Front panel

ACRONYM	SLOTS
TRBC1111	**any slots among 3 plus 23 and 18 plus 38**

Legenda	
Name	**Meaning**
PWR Green /Red led	This led is GREEN when the board is power supplied. This led is RED when one of the internal ±48V power supplies is failed or switched–off (e.g. at unit start–up, unit not configured)
RxA Yellow led	If switched ON it means that at least one of the following alarms occurs: ILOS_WDM, OTU2_LOF_WDM, OTU2_LOM_WDM, GEN_AIS_WDM. If switched OFF none of these alarms are raised.
TxA Yellow led	If switched ON it means that at least one of the following alarms occurs: ILOS_B&W, WOR, OPOR_VOA. If switched OFF none of these alarms are raised.
OOS Yellow led	It may light on in transitory state
Green / Yellow / Red led	The LED is – OFF when the board is plugged but not configured – green when the board is plugged, configured and without failure – red, meaning failure due to hardware failure, power supply failure or failure in communication on the board – yellow when a firmware download is being performed. The board must not be extracted*****
RJ45 (G.703)	RJ45 (G.703) connector (not used in current release)
Y	It allows to monitor the received WDM signal (from CMDX)
W	WDM Rx – WDM Reception: WDM input signal (from CMDX)
	WDM Tx – WDM Transmission: WDM output signal (to CMDX)
1) to **4)**	B&W input/output – User Reception/Transmission signals (from/to up to four clients)

N.B. ***** When a board is on firmware download state, the hardware failure led on the front board lights on yellow colour. **Never unplug a board while this LED is yellow. Should this occur, the board will not restart and may have to be returned for factory repair**.

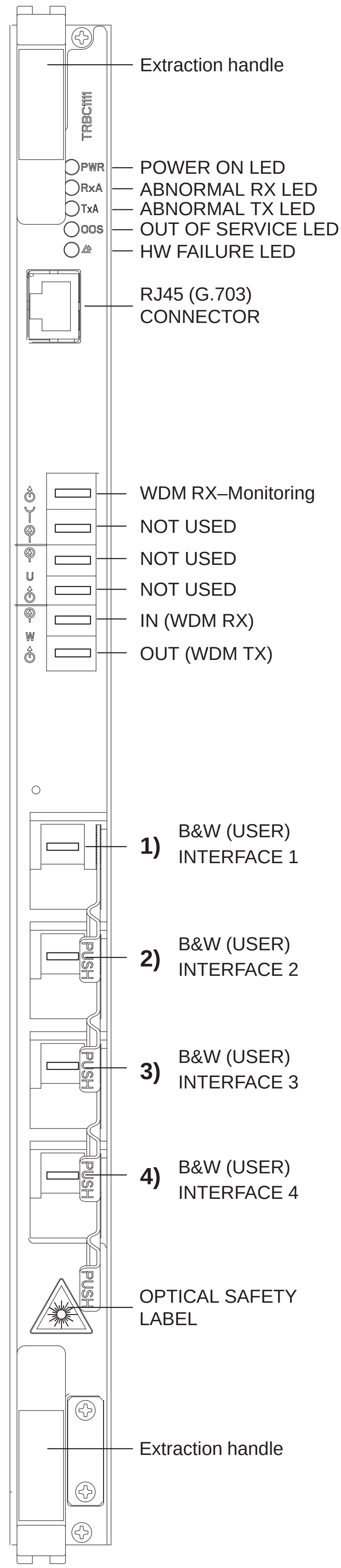
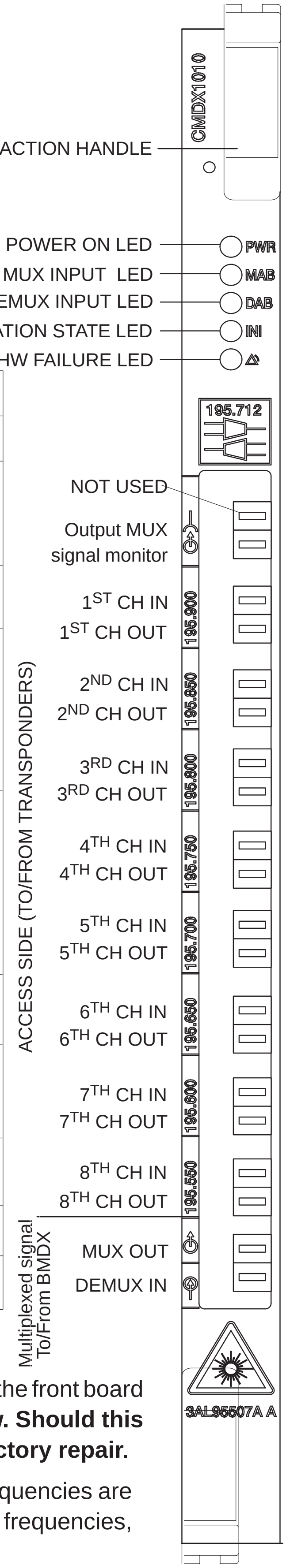


Figure 53. TRBC1111 board Front panel

ACRONYM	SLOTS
CMDX1010	**any slots among 2 and 19 (recommended slots: 2, 19)**



Legenda

Name	Meaning
PWR Green / Red led	This led is GREEN when the board is power supplied. This led is RED when one of the internal ±48V power supplies is failed or switched–off (e.g. at unit start–up, unit not configured)
MAB Yellow led	ON indicates signal failure at one or more of the eight CMX inputs (OR of the MUX INPUT ports, access side)
DAB Yellow led	ON indicates signal failure at the CDX input (multiplexed signal, at DEMUX input)
INI Yellow led	ON indicates that CMX (Mux) and/or CDX (Demux) are in the IN-Itialisation state and they are not yet at operating temperature (CMDX1010 only)
Green / Yellow / Red led	The LED is – GREEN when the board is plugged, configured and without failure – RED, meaning failure due to hardware failure, power supply failure or failure in communication on the board – Yellow when a firmware download is being performed***** – OFF when the board is plugged but has not been declared
	It allows to monitor the output multiplexed signal sent toward BMDX
195.900	Input/Output connection points of the 1st channel (towards client/TRBD)******: – the above connector is the output one (demux signal to be sent to client) – the below connector is the input one (signal from client has to be mux)
195.850 to 195.550	The same as the couple of connectors of the first channel, but it refers to the channels from 2 to 8 (for CMDX Band 1)
	Multiplexed/aggregate output signal, to be sent to BMDX
	Multiplexed/aggregate input signal, coming from BMDX

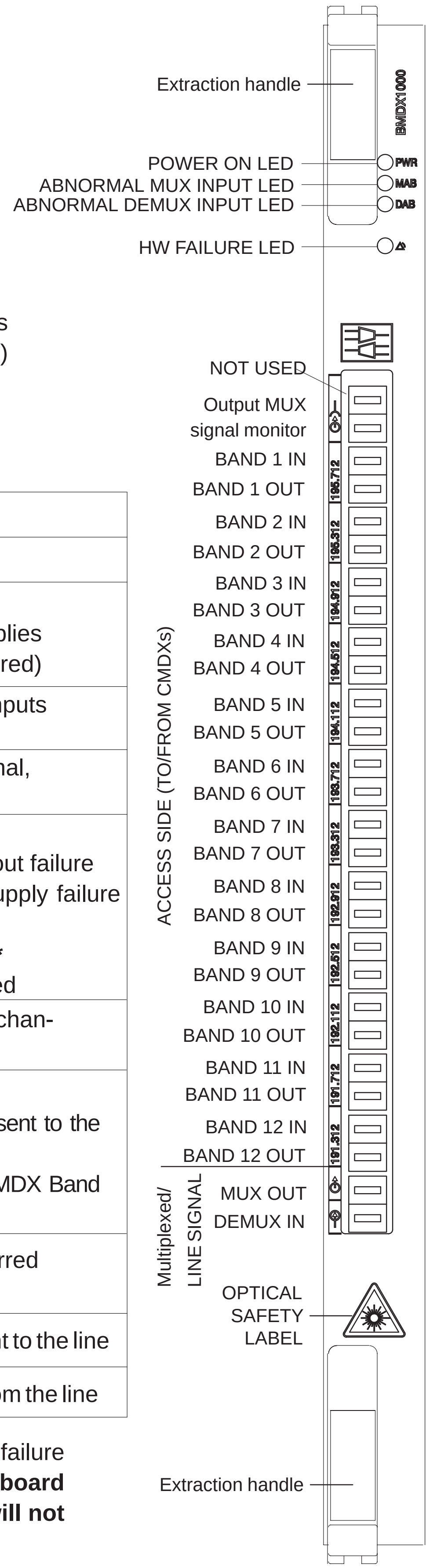
N.B. ***** When a board is on firmware download state, the hardware failure led on the front board lights on yellow colour. **Never unplug a board while this LED is yellow. Should this occur, the board will not restart and may have to be returned for factory repair**.

N.B. ****** In current figures is shown the band 1 CMDX and hence the printed frequencies are relevant to the band 1; on the band 2 to 10 (CMDX) are printed the relevant frequencies, different from the ones shown in this figure.

Figure 54. CMDX1010 board Front panel

ACRONYM	SLOTS
BMDX1000 (recommended slots: 3 plus 23)	**any slots among 3 plus 23 and 18 plus 38**
BMDX1100 (recommended slots: 3 plus 23 and 7 plus 27)	

In current figure is shown the BMDX1000: The BMDX1100 front view is the same, a part the acronym (BMDX1100) and the code (3AL 95504 AB)

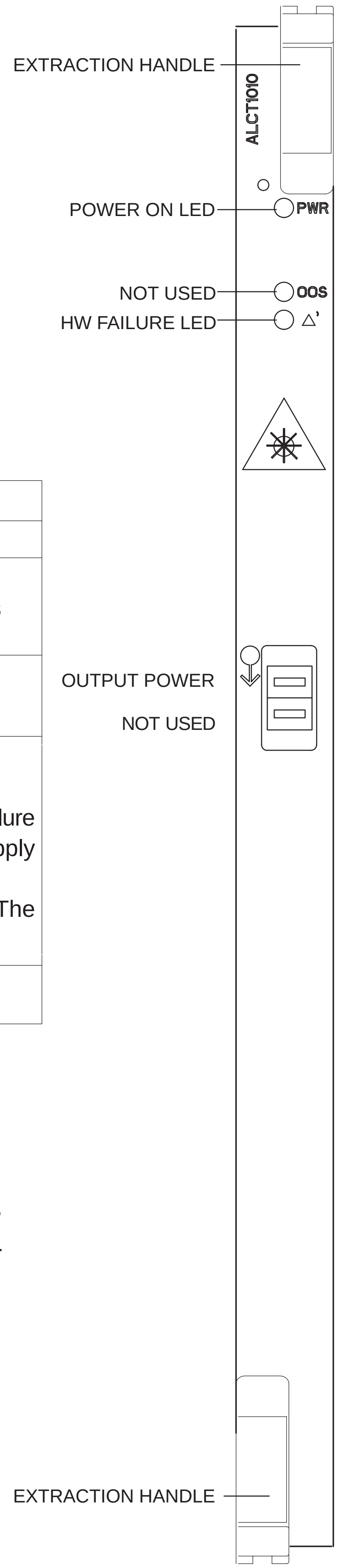


Legenda	
Name	**Meaning**
PWR Green / Red led	This led is GREEN when the board is power supplied. This led is RED when one of the internal ±48V power supplies is failed or switched–off (e.g. at unit start–up, unit not configured)
MAB Yellow led	ON indicates signal failure at one or more of the eight BMX inputs (OR of the MUX INPUT ports, access side)
DAB Yellow led	ON indicates signal failure at the BDX input (multiplexed signal, at DEMUX input)
Green / Yellow / Red led	The LED is – GREEN when the board is plugged, configured and without failure – RED, meaning failure due to hardware failure, power supply failure or failure in communication on the board – YELLOW when a firmware download is being performed***** – OFF when the board is plugged but has not been declared
	It allows to monitor the output multiplexed signal (up to 80 channels) sent to the line
195.712	Band 1 Input/Output connection points (with CMDX Band 1): – the above connector is the output one (demux signal to be sent to the CMDX Band 1) – the below connector is the input one (signal coming from CMDX Band 1 has to be mux by BMDX)
195.312 TO 191.312	The same as the couple of connectors of the Band 1, but referred to the Bands from 2 to 10
	Multiplexed/aggregate output signal (80 channels), to be sent to the line
	Multiplexed/aggregate input signal (80 channels), coming from the line

N.B. ***** When a board is on firmware download state, the hardware failure led on the front board lights on yellow colour. **Never unplug a board while this LED is yellow. Should this occur, the board will not restart and may have to be returned for factory repair**.

Figure 55. BMDX1X00 board front panel

ACRONYM	SLOTS
ALCT1010	**any slots among 3 and 18**

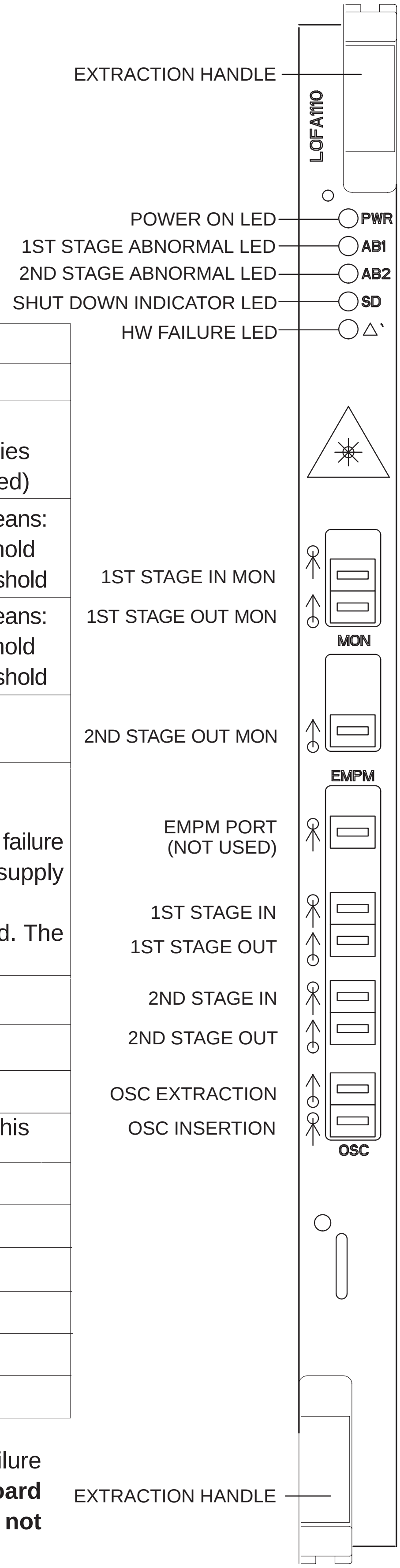


Legenda	
Name	**Meaning**
PWR Green /Red led	This led is GREEN when the board is power supplied. This led is RED when one of the internal ±48V power supplies is failed or switched–off (e.g. at unit start–up, unit not configured)
OOS Yellow led	It may light on in transitory state
Green / Yellow / Red led	The LED is – OFF when the board is plugged but not configured – GREEN when the board is plugged, configured and without failure – RED to indicate failure due to hardware failure, power supply failure or failure in communication on the board – YELLOW when a firmware download is being performed. The board must not be extracted*
OUTPUT POWER	OPTICAL OUTPUT POWER; CONNECTED TO BMDX INPUT

N.B. * When a board is on firmware download state, the hardware failure led on the front board lights on yellow colour. **Never unplug a board while this LED is yellow. Should this occur, the board will not restart and may have to be returned for factory repair**.

Figure 56. ALCT1010 front panel

ACRONYM	SLOTS
LOFA1110	any slots among
LOFA1120	3 and 18



Legenda	
Name	**Meaning**
PWR Green /Red led	This led is GREEN when the board is power supplied. This led is RED when one of the internal ±48V power supplies is failed or switched–off (e.g. at unit start–up, unit not configured)
AB1 Yellow led	Abnormal 1st stage input or output signal alarm. Turned ON it means: – input optical signal level below the IN signal LOS1 threshold – output optical signal level below the OUT signal LOS1 threshold
AB2 Yellow led	Abnormal 2nd stage input or output signal alarm. When ON, it means: – input optical signal level below the IN signal LOS2 threshold – output optical signal level below the OUT signal LOS2 threshold
SD Yellow led	When ON, it means one or both stages shut down
Green / Yellow / Red led	The LED is – OFF when the board is plugged but not configured – GREEN when the board is plugged, configured and without failure – RED to indicate failure due to hardware failure, power supply failure or failure in communication on the board – YELLOW when a firmware download is being performed. The board must not be extracted*
1ST STAGE IN MON	Extraction of the first stage input monitoring signal
1ST STAGE OUT MON	Extraction of the first stage output monitoring signal
2ND STAGE OUT MON	Extraction of the second stage output monitoring signal
EMPM PORT (NOT USED)	Insertion of EMPM power. A shutter protects the user when this port is not used
1ST STAGE IN	First stage input power
1ST STAGE OUT	First stage output power
2ND STAGE IN	Second stage input power
2ND STAGE OUT	Second stage output power
OSC EXTRACTION	Extraction of the OSC, before signal amplification
OSC INSERTION	Insertion of the OSC, after signal amplification

N.B. * When a board is on firmware download state, the hardware failure led on the front board lights on yellow colour. **Never unplug a board while this LED is yellow. Should this occur, the board will not restart and may have to be returned for factory repair**.

Figure 57. LOFA11y0 front panel

ACRONYM	SLOTS
ESCT1000	1

Legenda

Name	Meaning
URG Red led	It is ON if an Urgent Alarm is raised (major or critical)
NUR Red led	It is ON if a Not Urgent Alarm is raised (minor)
ATD Yellow led	Attended Alarm indication. It is – lit ON when the operator has acknowledged the alarms by pushing ACO button – lit OFF when all the acknowledged alarms are cleared
EC Green / Red / yellow led	Indicates the state of the EC processor. Led states: – green led: board present, active, config. and no failure – red led: EC function not operational – yellow led: EC in stand–by mode (used in case of ESCT1000 redundancy) or starting or the board is present but not SW configured. N.B. Even if ESCT only supports SC functionality, EC LED is green except if this ESCT which is in a slave shelf has not been connected yet to the master shelf (software has not ben downloaded), EC LED is yellow.
SC Green / Red / Yellow led	Indicates the state of the SC processor – green led: board present, active, configur. and no failure – red led: SC function not operational – yellow led: SC in standby mode (used in case of ESCT redundancy) or (re)starting or the board is present but not SW configured.
RST	Allows the ESCT1000 board to restart
ACO	Allows the alarm storing (attended); the ATD led lights ON
LT	Lamp test; it lights ON all the leds of the NE
DBG	Debugger interface/RJ45 connector, for factory tests only
1)	F interface: SUB–D 9–pole connector for CT connection
2)	Q interface: BNC conn. for (10Base2) NMS connection
3)	Q interface: RJ45 conn. for (10BaseT) NMS connection
4)	BNC connector for intra–shelves link (10Base2)
5)	RJ45 connector for intra–shelves link (10BaseT)

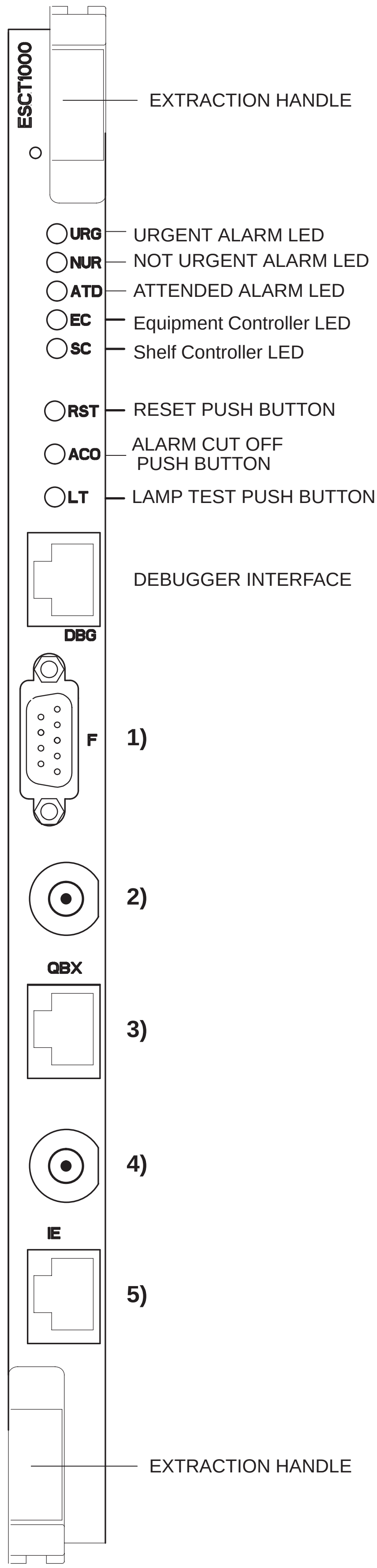
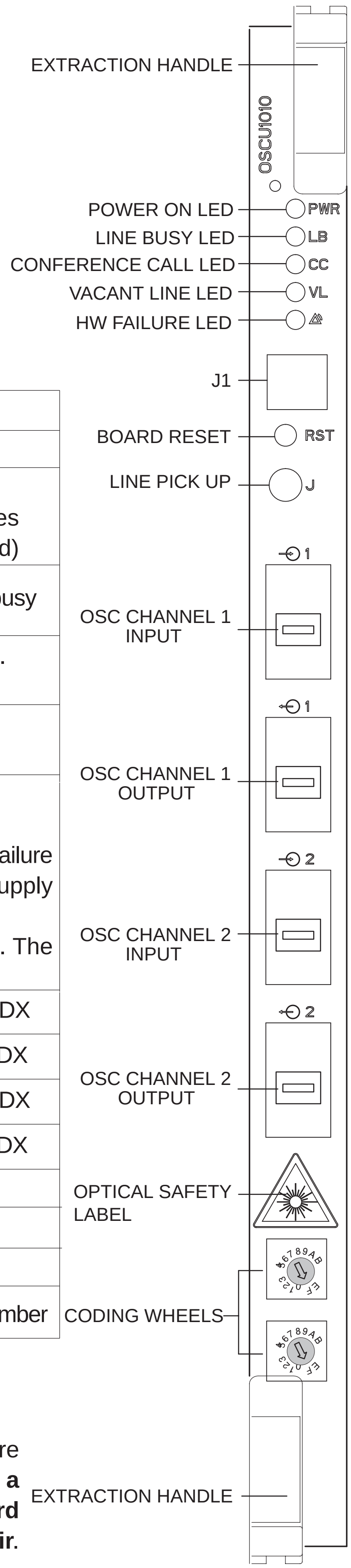


Figure 58. ESCT1000 front panel

ACRONYM	SLOTS
OSCU1010	any slots among 3 plus 23



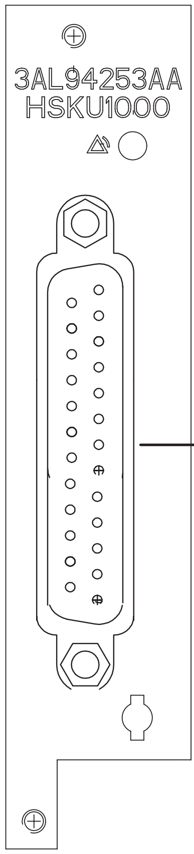
Legenda

Name	Meaning
PWR Green /Red led	This led is GREEN when the board is power supplied. This led is RED when one of the internal $\pm$48V power supplies is failed or switched–off (e.g. at unit start–up, unit not configured)
LB Yellow led	Line Busy led; it is ON when the phone line (speech channel) is busy
CC Yellow led	Conference Call led; it is ON when a conference call is occuring. This LED is blinking when the phone is ringing
VL Green led	Vacant Line led; it is ON when the line is vacant
Green / Yellow / Red led	The LED is – OFF when the board is plugged but not configured – GREEN when the board is plugged, configured and without failure – RED to indicate failure due to hardware failure, power supply failure or failure in communication on the board – YELLOW when a firmware download is being performed. The board must not be extracted*
1	Optical Supervisory Channel 1 Rx input signal, from LOFA or BMDX
1	Optical Supervisory Channel 1 Tx output signal, to LOFA or BMDX
2	Optical Supervisory Channel 2 Rx input signal, from LOFA or BMDX
2	Optical Supervisory Channel 2 Tx output signal, to LOFA or BMDX
J1	Speech channel handset connector
RST	Board reset push button
J	Line pick up push button; push to button to get the line
CODING WHEELS	Speech channel number coding wheels, to set the NE phone number

N.B. * When a board is on firmware download state, the hardware failure led on the front board lights on yellow colour. **Never unplug a board while this LED is yellow. Should this occur, the board will not restart and may have to be returned for factory repair**.

Figure 59. OSCU1010 front panel

ACRONYM	SLOTS
HSKU1000	22, 39 (Recommended slot : 22)

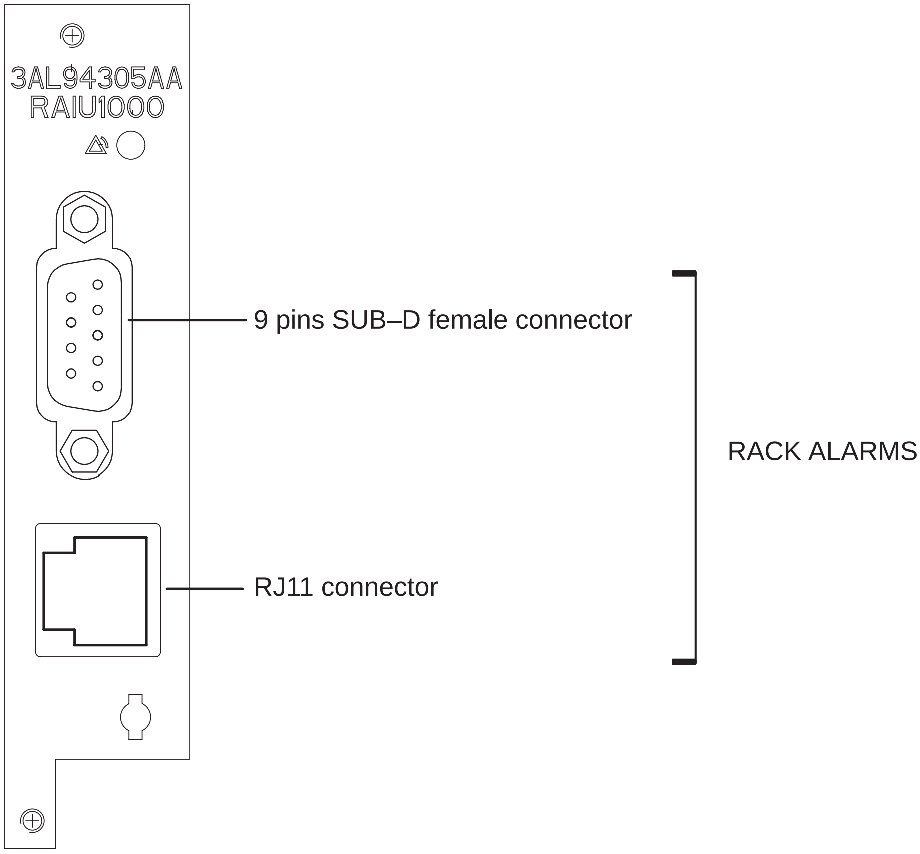


25 pins SUB–D female connector for housekeeping alarms (8 functional inputs + 8 functional outputs, plus additional signals necessary for reference voltages)

Legenda	
Name	**Meaning**
Green / Red led	The LED is – OFF when the board is plugged but not configured – GREEN when the board is plugged, configured and without failure – RED to indicate failure due to hardware failure, power supply failure or failure in communication on the board

Figure 60. HSKU1000 front panel

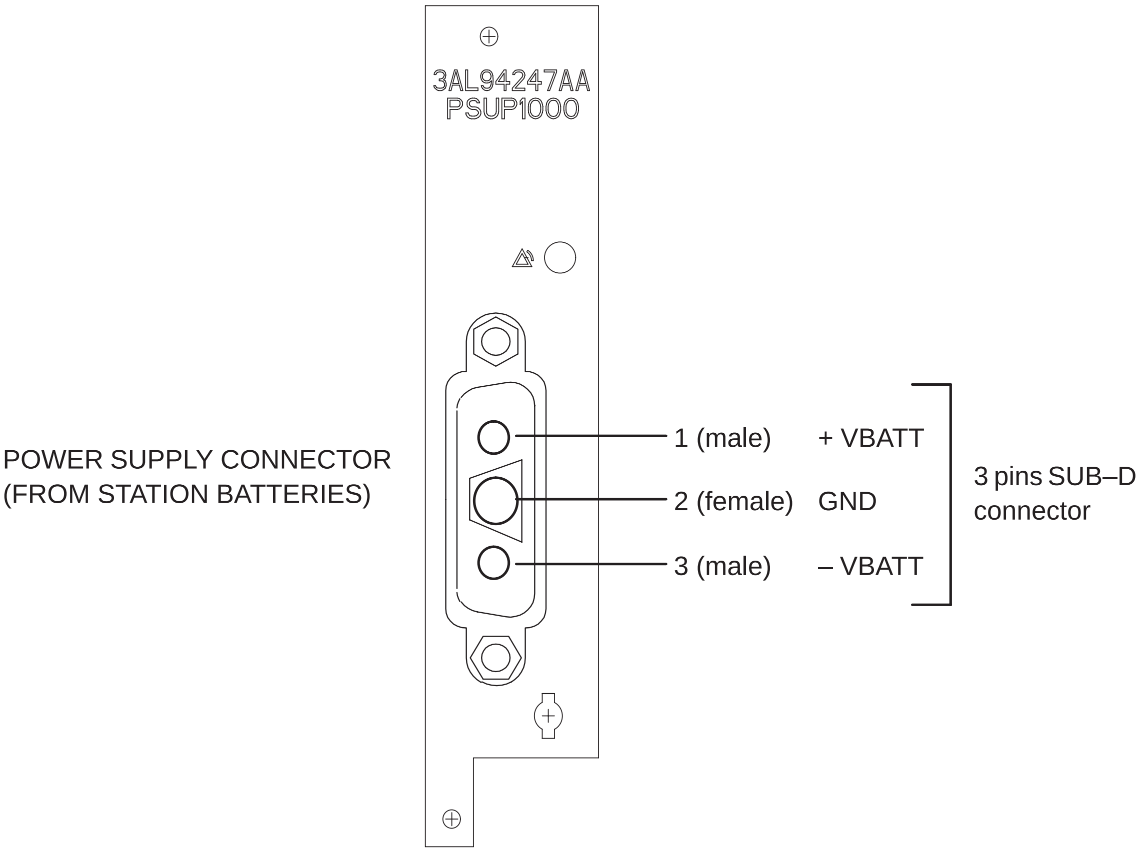
ACRONYM	SLOTS
RAIU1000	**22, 39 (recommended slot: 39)**



Legenda	
Name	**Meaning**
Green / Red led	The LED is – OFF when the board is plugged but not configured – GREEN when the board is plugged, provisioned and without failure – RED when at least one of the on–board power supplies is failed
9 pins SUB–D female connector	In master shelf it has to be connected to the TRU. In slave shelf it can be connected – to the TRU, in point–to–point links – to the (RAIU1000) RJ11 connector of the shelf above, in intra–shelf (chain) connection
RJ11 connector	Used in intra–shelf (chain) connection only, it is connected with the (RAIU1000) SUB–D 9–pin connector of the slave shelf below

Figure 61. RAIU1000 front panel

ACRONYM	SLOTS
PSUP1000	21, 40

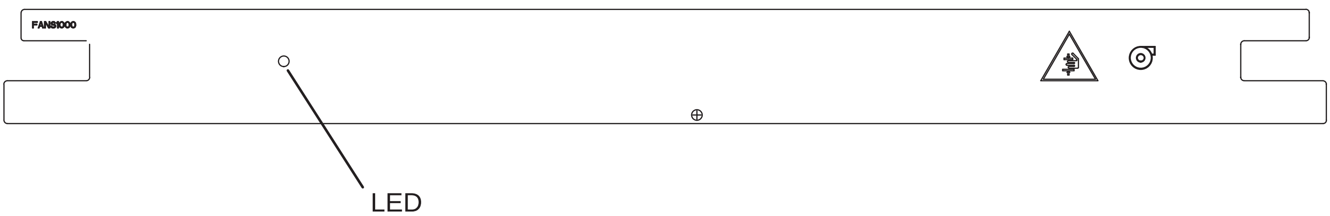


Legenda	
Name	**Meaning**
Green / Red led	The LED is – OFF when the unit is plugged but not configured. – GREEN when the board is plugged, configured and without failure – RED to indicate failure due to hardware failure, power supply fail ure or failure in communication on the board

Figure 62. PSUP1000 front panel

ACRONYM	SLOTS
FANS1000	41

FANS1000



Legenda	
Name	**Meaning**
Green / Red led	The LED is – OFF when the board is plugged but not configured – GREEN when the board is plugged, configured and without failure – RED to indicate failure due to hardware failure, power supply fail ure or failure in communication on the board

Figure 63. FANS1000 front panel

ACRONYM	EQUIPPED ON PORT
SFP S–16.1	TRBC1111

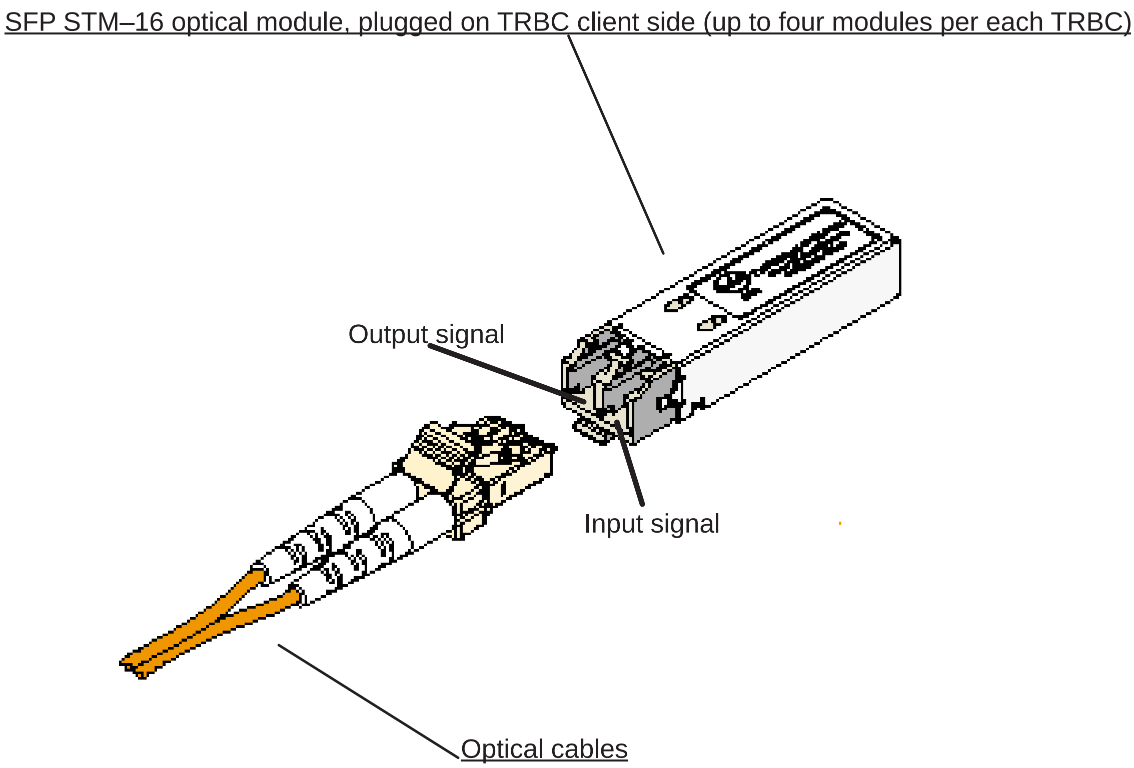


Figure 64. STM–16 optical module (SFP S–16.1)

3 FUNCTIONAL DESCRIPTION

3.1 General description

This section describes the main functions carried out by the 1626 LIGHT MANAGER Rel.2.0 Alcatel product.

The functions carried out by the NE, can be split in some sub–systems herebelow listed, and described from para. 3.1.1 to para.3.1.9:

- **Transponder sub–system –** see para.3.1.1
- **Optical MUX/DEMUX (Wavelength Division Multiplexing) sub–system**, see para. 3.1.2
- **Optical Fiber Amplification (OFA) sub–system** – optional. See para. 3.1.3
- **Supervision management (Optical Supervisory Channel, OSC) sub–system** – optional. See para. 3.1.4
- **Controller sub–system**, see para. 3.1.5
- **Power supply sub–system**, see para. 3.1.6
- **Protection sub–system**, see para. 3.1.7
- **Performance Monitoring sub–system**, see para. 3.1.8.
- **Remote Inventory sub–system**, see para. 3.1.9

Before starting with the presentation of the above listed functions / sub–systems, for a better system comprehension, will be described the 1626 LM mux/demux scheme and the main configurations (Line Terminal, Line Repeater, OADM, back–to–back terminal).

Generic 1626 LM mux/demux scheme

The 1626 LM platform supports up to 96 channels at 10Gbps in extended C–band with 50 GHz spacing. The channel grid is compliant with the ITU–T standard. The optical spectrum goes from 1530nm to 1568nm. Refer to Figure 65. on page 121 as an example.

In ingress direction (B&W to WDM) the transponder is the first unit of the system transmission chain. We can have two types of transponders :

– TRiButary Direct (TRBD) which converts the
  - 9.95320 Gbps : STM–64/ OC–192/10GBE WAN... in UNI mode
  - 10.709 Gbps, in NNI mode provided in future rel.
  - 10.3125 Gbps : GB Ethernet LAN, in UNI mode

  B&W signal coming from client's equipment into the
  10.709 Gbps WDM coloured one, for 9.95320 Gbps and 10.709 Gbps bit rates
  11.09 Gbps WDM coloured one, for 10.3125 Gbps bit rate.

– TRiButary Concentrator (TRBC) which converts up to four 2.488 Gbps (UNI mode) / 2.666 Gbps (NNI mode, future rel.) B&W signals (STM–16/OC–48) coming from client into the 10.709 Gbps WDM coloured one.

The transponder WDM output is routed to the multiplexing section.

The Multiplex scheme is made up of two units: CMDX and BMDX.
The 8:1 Channel Mux/DemuX (CMDX) is able to multiplex up to 8 channels into a single output port; up to twelve CMDXs can be used.
The output signal is further routed to the 12:1 Band Mux/DemuX, BMDX, able to multiplex up to 12 input signals/bands into a composite WDM output signal, providing the optical aggregate to be transmitted into the optical line.
The aggregate signal is sent to the LOFA to be sent to the line. The LOFA amplifies the signal to increase its optical power in order to feed the optically amplified line with the appropriate power level.
During propagation, the signal optical power decreases because of the attenuation of the fiber. To cope with this effect, optical line amplifiers (Line Repeaters) are deployed along the link in order to periodically amplify the signal.

In egress direction (WDM to B&W) the aggregate signal, cointaining up to 12 bands, each of 8–channel, is first filtered (OSC extraction) and then pre–amplified with 1, 2 or 3 line amplifiers (LOFA) to be sent to the 1626 LM mux/demux stage.
The 12:1 Band Mux/DemuX (BMDX) demultiplexes the received aggregate signal providing up to 12 output signals (12 bands), each one has to be sent to the appropriate CMDX. Then, up to twelve CMDXs can be used, each one working in a different band, hence covering the entire Extended C–band.
Then each 1:8 Channel Mux/DemuX (CMDX) demultiplexes the received band into 8 coloured wavelengths/channels to be sent to the relevant transponder, performing the conversion to

- one 9.95320 Gbps (UNI) / 10.709 Gbps (NNI, future rel.) (STM–64/OC–192/10GBE WAN...) / 10.3125 Gbps (10GBE LAN, in UNI mode) B&W signal
- four 2.488 Gbps (UNI) / 2.666 Gbps (NNI, future rel.) B&W signals (STM–16/OC–48)

to be sent to the client's equipment(s).

If needed, DCU modules can be inserted in LOFA mid–stage or between cascaded LOFAs.

The Optical Supervisory Channel (added/dropped at the output/input of the Line Amplifier) allows to supervise all the NEs along the WDM transmission path. From current rel. it is managed by the 1626 LM and the relevant information is given to the ESCT1000 by means of a back panel connection.

The SPI is a serial bus connecting SC with the boards, used for remote inventory, provisioning, control...
The RAIU1000 monitors the racks alarms to light ON or OFF the lamps of the TRU.

The HSKU1000 provides 8 input accesses and 8 output accesses, managed by CT/1353SH.

The PSUP1000 works in “1+1” protected manner, supplying the units in the subrack with nominal 48V/60V, 3.3V and 5V supplies. Most units derive their own supply voltages from the 48V/60V.

Main 1626 LM configurations

Line Terminal configuration

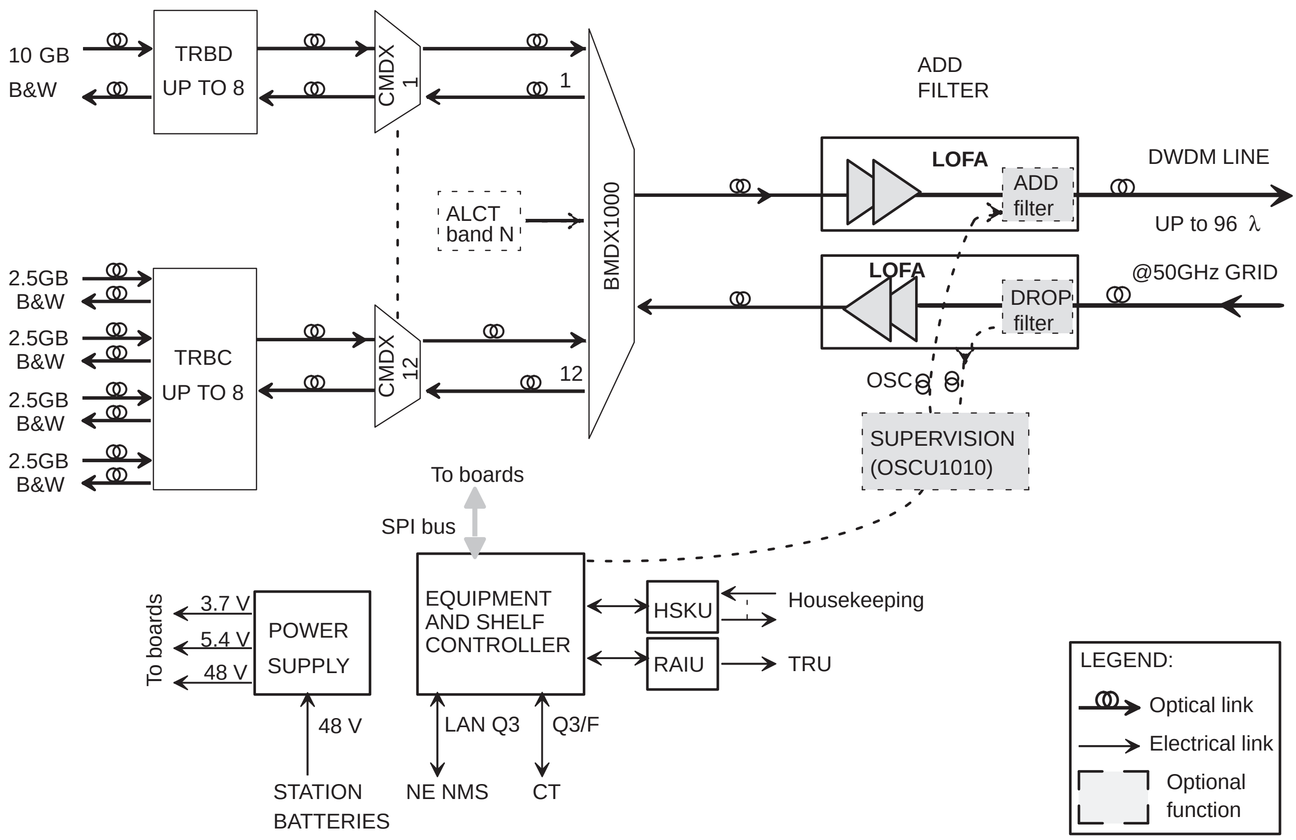


Figure 65. Line Terminal

In Line Terminal configuration, can be sent to the line up to 96 channels.
From current release, all the boards belong to 1626 LM.
The used BMDX is the BMDX1000 (band mux/demux).
ALCT is used to facilitate the loading of the system. The ALCT band is specified according to the link design (default is B5). Typically one board is used in LT (but a higher number may be used), in order to substitute the relevant missing CMDX(s). In case of 12 bands installed, no ALCT is needed.
For the functional description, see the **Generic 1626 LM mux/demux scheme**, above described.

The line terminal also supports a specific configuration for unrepeatered applications, based on three pre-amplifiers and one booster.

Line Repeater configuration

The line repeater consists of two optical double–stage in–line amplifiers (providing a bidirectional DWDM amplifier) in order to boost the optical power of the aggregate WDM signal avoiding channels demux and regeneration (no optical to electrical conversion).
In fact the MUX/DEMUX and Transponder functions are not implemented and the equipment acts as an in line amplifier, which allows nevertheless the Optical Supervision Channel (OSC) and the supervision functions.

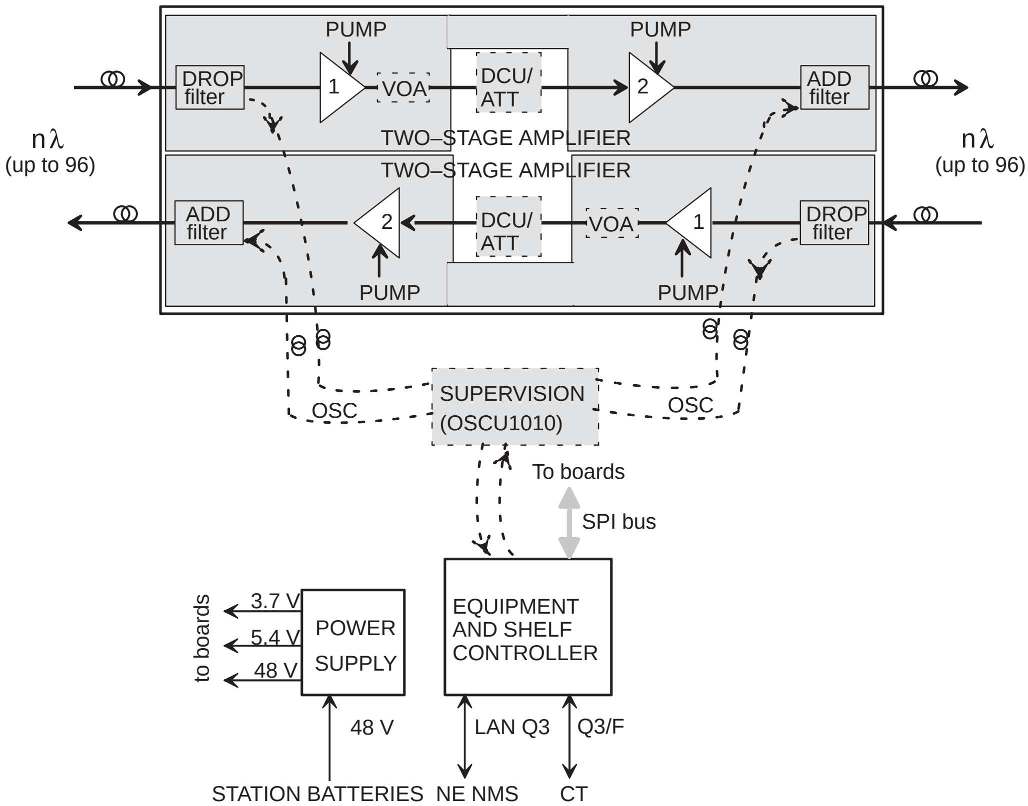


Figure 66. Line Repeater

OADM configuration

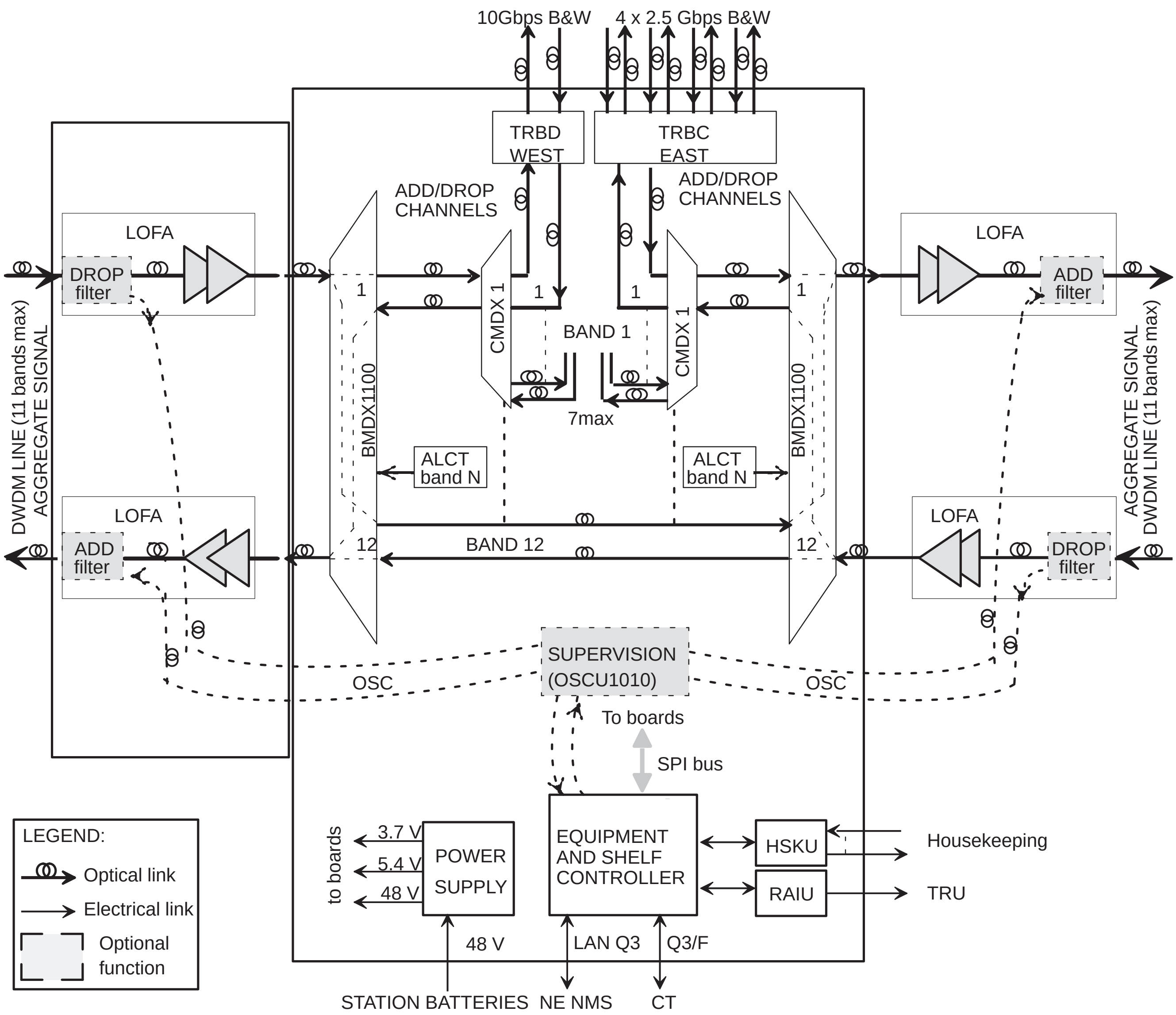


Figure 67. Optical Add and Drop Multiplexer repeater

In OADM repeater configuration can be sent to the line up to 11 bands per direction (because 1 band is occupied by ALCT, default = B5), with a 7–wavelenght @ 50 GHz granularity per band, both in case of bidirectional add/drop (symmetrical configuration) and unidirectional add/drop (asymmetrical configuration).
From current release, all the boards belong to 1626 LM.
The aggregate signal coming from the line, after OSC extraction and signal preamplification, is demultiplexed by the Band OADM (BMDX1100) that provides the max 11 bands (output signals) routed to the relevant CMDX. Each CMDX demultiplexes the proper band providing 7 x WDM output signals sent to the appropriate transponder. Each transponder converts the WDM coloured signal into the 10 Gbps B&W (TRBD) or the 4 x 2.5 Gbps B&W (TRBC) signals routed to the client.
In ingress (B&W to WDM) direction, the reverse operation is realized.
Up to 100% of the wavelenghts can be added/dropped. The non–added/dropped channels are in complete pass–through, without any (3R) regeneration.
ALCT is used to facilitate the loading of the system. The ALCT band is specified according to the link design (default is B5). Typically two boards are used in OADM (but a higher number may be used), in order to substitute the relevant missing CMDXs (2 ALCTs have always to be plugged in OADM).

Back–to–back Terminal configuration

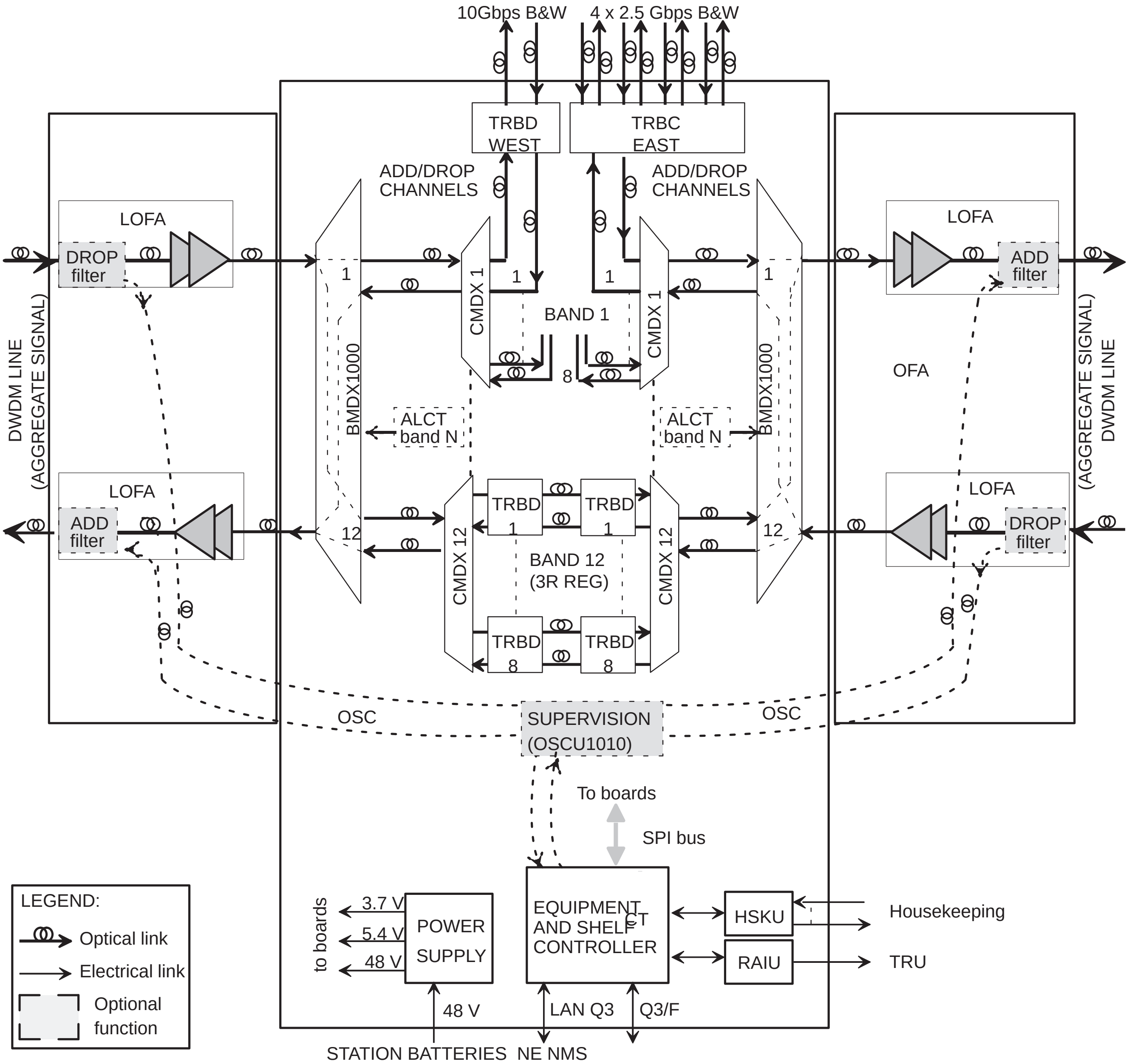


Figure 68. Back–to–back terminal

In back to back terminal configuration, up to 96 channels (12 bands) can be sent to the line in both directions. The aggregate signal coming from the line, after OSC extraction and signal preamplification, is demultiplexed by the Band Mux/Demux (BMDX1000) providing the max 12 bands/output signals routed to the relevant CMDX. Each CMDX demultiplexes the proper band providing 8 x WDM outputs sent to the appropriate transponder. Each transponder converts the WDM coloured signal into the 10 Gbps B&W (TRBD) or the 4 x 2.5 Gbps B&W (TRBC) signals routed to the client.
In ingress (B&W to WDM) direction, the reverse operation is realized.
Up to 100% of the wavelenghts can be added/dropped. The non–added/dropped channels are 3R (Re–timing, Re–shaping, Re–transmitting) regenerated.
ALCT is used to facilitate the loading of the system. The ALCT band is specified according to the link design (default is B5). Typically two boards are used in OADM (but a higher number may be used), in order to substitute the relevant missing CMDXs (no ALCT plugged if 12 CMDXs per side are present).

3.1.1 Transponder sub–system

The transponder sub–system is based on
- transponders, which perform frequency adaptation, but not Time Division Multiplexing (also called concentration); they are called TRBDwxyz
- concentrators, which perform both frequency adaptation and time division multiplexing and demultiplexing of several client signals; they are called TRBCwxyz.

The transponder and concentrator sub–system is built on
- TRiButary Direct (TRBD1110, TRBD1111, TRBD1011, TRBD1121, TRBD1131)
- TRiButary Concentrator (TRBC1111).

The TRBD units are bidirectional G.709 transponders with one B&W and one coloured optical interfaces. TRBD1110 and TRBD1131 provide only User to Network Interface (UNI).
TRBD1111, TRBD1121 and TRBD1011 provide both UNI and NNI (Network Node Interface, in future rel.).

The TRBC unit is a bidirectional G.709 transponders with four B&W and one coloured optical interfaces. TRBC1111 provides both UNI and NNI (Network Node Interface, in future rel.).

<u>NNI will be fully operative in future releases.</u>

According to the board type, the TRBDs convert
- one 9.9532 Gbps (STM–64/OC–192/10GBE WAN..), in UNI mode or
- one 10.709 Gbps (OTU–2), in NNI mode (future rel.) or
- one 10.3125 Gbps (10GB Ethernet LAN), in UNI mode

B&W signal coming from client into the 10.709 Gbps WDM coloured one and viceversa.

The TRBC concentrates
- up to four 2.488 Gbps (STM–16/OC–48..), in UNI mode or
- up to four 2.666 Gbps (OTU–1), in NNI mode (future rel.)

B&W signals coming from client into the 10.709 Gbps WDM coloured signal and viceversa.

The role of this function is:

- **in ingress direction** (from client to WDM line):
  to adapt (and to concentrate for TRBC) each client incoming optical signal(s) to a dedicated coloured wavelength and deliver the optical signals to the multiplexer function (CMDX board).

- **in egress direction** (from DWDM line to client):
  to restitute the 10 Gbps (or the four 2.5Gbps) client optical signal(s) from the coloured signal delivered by the demultiplexer (CMDX board) function.

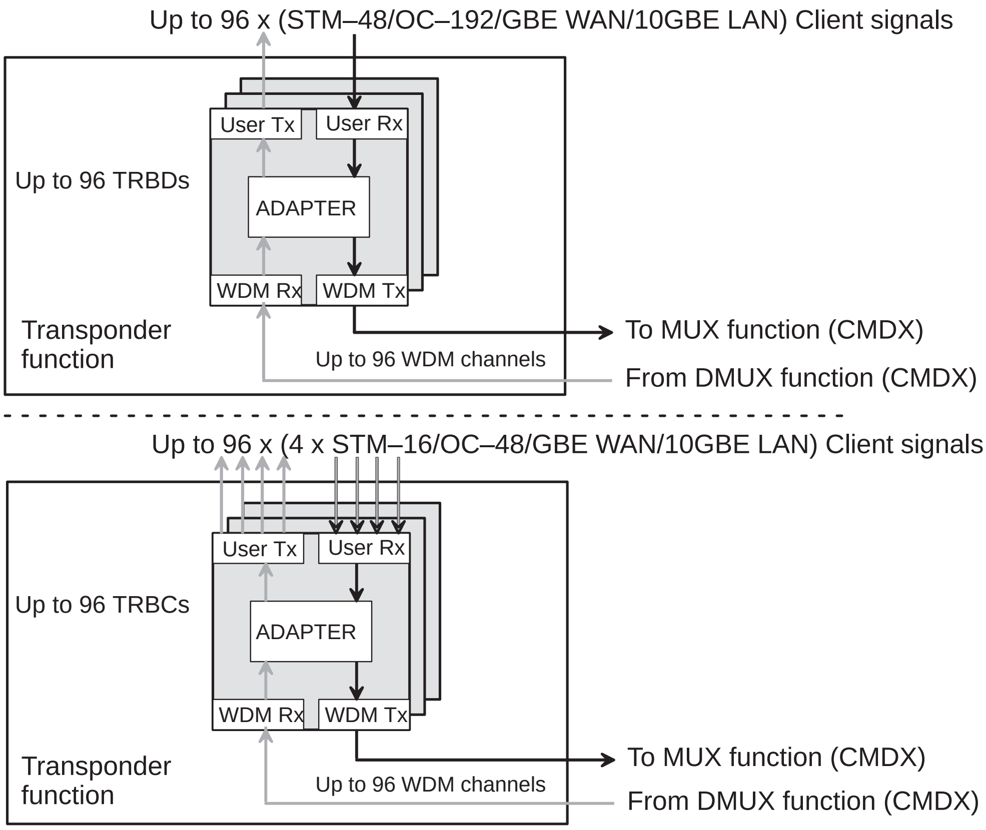


Figure 69. Line terminal transponder function

In back–to–back and OADM configuration, the transponder number is doubled and is able to transmit and receive the clients signals in two directions (east/west). It is able to optionally provide Optical Sub–Network Connection Protection (O–SNCP), see section 3.1.7, page 147.

Up to 96 (back–to–back / OADM) STM–64/OC–192/10GBE Client signals (with TRBD using)
Up to 384 (back–to–back / OADM) STM–16/OC–48 Client signals (with TRBC using)

BY MEANS OF AN ADDITIONAL NE, NAMED OCP, IT IS POSSIBILE TO SEND THE SAME CLIENT SIGNAL IN BOTH DIRECTIONS, THUS REALIZING THE OPTICAL CHANNEL PROTECTION (O–SNCP IN RING NETWORKS)

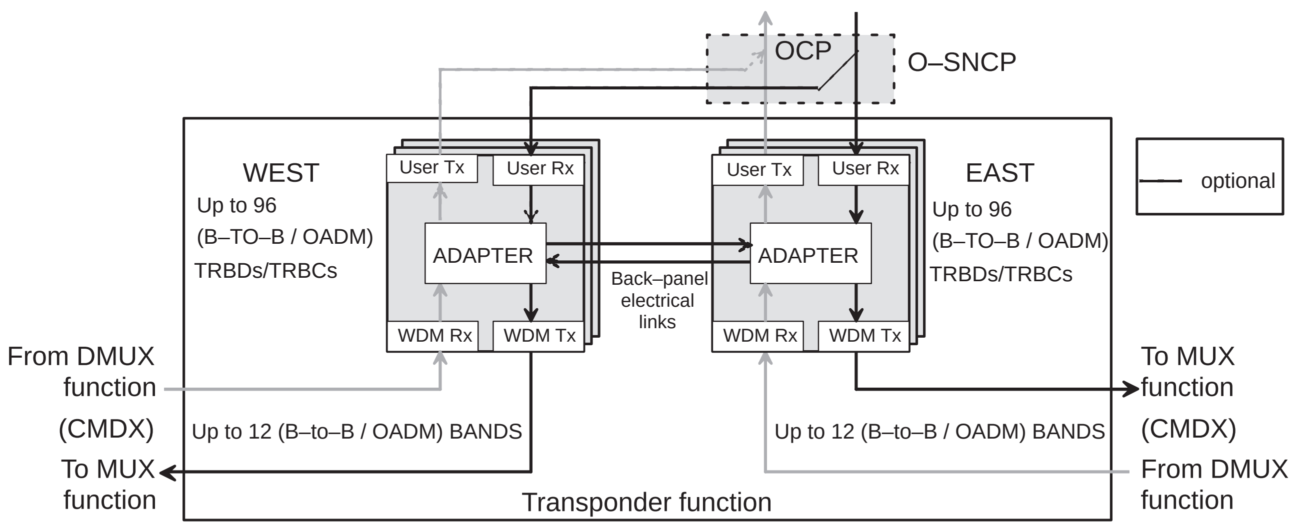


Figure 70. Back–to–back terminal / OADM transponder function

3.1.1.1 Client signals

3.1.1.1.1 TRBDs client signals

The B&W interface of the TRBD boards complies with the following standards:

- ITU–T G.691 I–64.1 ; S–64.2b
- ITU–T G.693 VSR 2000–2R1
- IEEE 802.3 10GBASE–LR

In UNI mode the following B&W signals at 9.95320 and (GBE LAN only) 10.31 Gbps can be processed

- STM–64
- OC–192
- 10 Gbps Ethernet WAN
- other 9.9532 Gbps client signals (e.g. PRBS)
- 10 Gbps Ethernet LAN.

In NNI mode the B&W signals are OTU–2 at 10.709 Gbps. NNI will be fully operative in future release.

The tranponders perform the 3R (Re–time, Re–Transmit, Re–shape) regeneration of the signal.

The **TRBD1011** is provided with high sensitivity receiver, ILM coloured interface – NRZ modulation, VSR B&W interface, Smeraldo ASIC (high FEC gain). It is tunable over two frequencies in C–band.

The **TRBD1111** is provided with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, VSR B&W interface, Smeraldo ASIC (high FEC gain). According to the board type (different P/N) it can be tunable over the full C–band or over a sub–band of 8 frequencies.

The **TRBD1110** is provided with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, VSR B&W interface, Tiziano ASIC (medium FEC gain).

The **TRBD1121** is provided with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, Intermediate reach (S64.2b) B&W interface, Smeraldo ASIC (high FEC gain). According to the board type (different P/N) it can be tunable over the full C–band or over a sub–band of 8 frequencies.

The **TRBD1131** is provided with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, 10GBASE–LR B&W interface (10 Km reach, 1310nm), Smeraldo ASIC (high FEC gain). It is tunable over the full C–band.

3.1.1.1.2 TRBC1111 client signals

The B&W interfaces of the TRBC boards are Small Form factor Pluggable modules compliant with the the S–16.1 standard.

In UNI mode the following B&W signals at 2.488 Gbps can be processed

- ITU–T G.957 STM–16
- OC–48

In NNI mode the B&W signals are OTU–1 at 2.666 Gbps. NNI will be fully operative in future release.

The tranponders perform the 3R (Re–time, Re–Transmit, Re–shape) regeneration of the signal.

The **TRBC1111** is provided with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, VSR B&W interface, Smeraldo ASIC (high FEC gain). It is tunable over the full C–band.

3.1.1.2 Optical channels

The 1626 LM transmits the 96 possible channels in the Extended C–band.
Table 12. on page 129 gives the nominal central frequencies allocation plan, based on the 50 GHz channel spacing anchored to a 193.100 THz reference (ITU–T standard grid).

The C–band is split into 12 sub–bands supporting 8 channels each, corresponding to the CMDXs 8–channel bands, to show the association between each 8–channel band (8 transponders) and the relevant mux/demux (CMDX board). Hence, the 8 channels from 195.900 GHz and 195,550 GHz (Band 1) are connected (mux/demux) to the CMDX Band 1, the 8 channels from 195.500 GHz and 195,150 GHz (Band 2) are connected to the CMDX Band 2...and so on for the other bands (up to Band 12).

The channel number (eg. 195900) is how channel are labelled both on the units and on the User Interface.

NOTES:

Some boards (TRBD1011) are tunable over two frequencies, 50 GHz spaced. 48 different boards are able to cover the 96 channels, in Line Terminal configuration (in back–to–back terminal and OADM configurations the boards are doubled).

Some other boards (TRBD1111, TRBD1121) are tunable over eight frequencies, 50 GHz spaced. 13 different boards are able to cover the 96 channels, in Line Terminal configuration (in back–to–back terminal and OADM configurations the boards are doubled).

Some other boards (TRBD1110, TRBD1111, TRBD1121, TRBD1131, TRBC1111) are tunable over the whole Extended C–band. The same board (x 96) is able to cover the 96 channels, in Line Terminal configuration (in back–to–back terminal and OADM configurations the boards are doubled).

Mixed configurations (TRBD and TRBC in the same NE) are allowed.

Table 12. Nominal frequencies allocation plan in C–Band

Band	Central frequency (THz)	Channel Number	Central wavelength (nm)
Band 1	195.900	195900	1530,33
	195.850	195850	1530,72
	195.800	195800	1531,11
	195.750	195750	1531,50
	195.700	195700	1531,90
	195.650	195650	1532,29
	195.600	195600	1532,68
	195,550	195550	1533,07
Band 2	195.500	195500	1533,46
	195.450	195450	1533,86
	195.400	195400	1534,25
	195.350	195350	1534,64
	195.300	195300	1535,03
	195.250	195250	1535,43
	195.200	195200	1535,82
	195,150	195150	1536,21
Band 3	195.100	195100	1536,61
	195.050	195050	1537,00
	195.000	195000	1537,39
	194.950	194950	1537,79
	194.900	194900	1538,18
	194.850	194850	1538,58
	194.800	194800	1538,97
	194.750	194750	1539,37
Band 4	194.700	194700	1539,76
	194.650	194650	1540,16
	194.600	194600	1540,55
	194.550	194550	1540,95
	194.500	194500	1541,35
	194.450	194450	1541,74
	194.400	194400	1542,14
	194.350	194350	1542,54

Band	Central frequency (THz)	Channel Number	Central wavelength (nm)
Band 5	194.300	194300	1542,93
	194.250	194250	1543,33
	194.200	194200	1543,73
	194.150	194150	1544,13
	194.100	194100	1544,52
	194.050	194050	1544,92
	194.000	194000	1545,32
	193.950	193950	1545,72
Band 6	193.900	193900	1546,12
	193.850	193850	1546,52
	193.800	193800	1546,91
	193.750	193750	1547,31
	193.700	193700	1547,71
	193.650	193650	1548,11
	193.600	193600	1548,51
	193.550	193550	1548,91
Band 7	193.500	193500	1549,31
	193.450	193450	1549,71
	193.400	193400	1550,11
	193.350	193350	1550,51
	193.300	193300	1550,92
	193.250	193250	1551,32
	193.200	193200	1551,72
	193.150	193150	1552,12
Band 8	193.100	193100	1552,52
	193.050	193050	1552,92
	193.000	193000	1553,33
	192.950	192950	1553,73
	192.900	192900	1554,13
	192.850	192850	1554,53
	192.800	192800	1554,94
	192.750	192750	1555,34

Band	Central frequency (THz)	Channel Number	Central wavelength (nm)
Band 9	192.700	192700	1555,74
	192.650	192650	1556,15
	192.600	192600	1556,55
	192.550	192550	1556,96
	192.500	192500	1557,36
	192.450	192450	1557,77
	192.400	192400	1558,17
	192.350	192350	1558,58
Band 10	192.300	192300	1558,98
	192.250	192250	1559,39
	192.200	192200	1559,79
	192.150	192150	1560,20
	192.100	192100	1560,60
	192.050	192050	1561,01
	192.000	192000	1561,42
	191.950	191950	1561,82
Band 11	191.900	191900	1562,23
	191.850	191850	1562,64
	191.800	191800	1563,04
	191.750	191750	1563,45
	191.700	191700	1563,86
	191.650	196550	1554,27
	191.600	191600	1564,68
	191.550	191550	1565,08
Band 12	191.500	191500	1565,49
	191.450	191450	1565,39
	191.400	191400	1566,31
	191.350	191350	1566,72
	191.300	191300	1567,13
	191.250	191250	1567,54
	191.200	191200	1567,95
	191.150	191150	1568,36

3.1.2 Optical MUX/DEMUX (Wavelength Division Multiplexing) sub–system

The optical multiplexer function
- receives from the transponder sub–system the coloured optical channels
- multiplexes them into a WDM signal
- launches the WDM signal on the line.

The optical demultiplexer function
- receives the WDM line signal
- demultiplexes this signal
- sends the recovered optical channels to the transponder sub–system.

The multiplexer/demultiplexer sub–system is performed by means of two types of Mux/Demux boards:

- the 8:1 and 1:8 @50GHz Channel Multiplexer/DemultipleXer (CMDX1010). It multiplexes the channels into bands and viceversa: since each CMDX operates on a single 8–channel band, 12 different CMDXs (see Table 12. on page 129 for the frequency allocation) are needed to cover the entire Extended C–Band

- the 12:1 and 1:12 @50GHz Band Multiplexer/DemultipleXer. It multiplexes the bands into the aggregate signal and viceversa. The following boards are used:
  - the BMDX1000, in line terminal and back–to–back terminal configurations
  - the BMDX1100, in OADM repeater configuration.

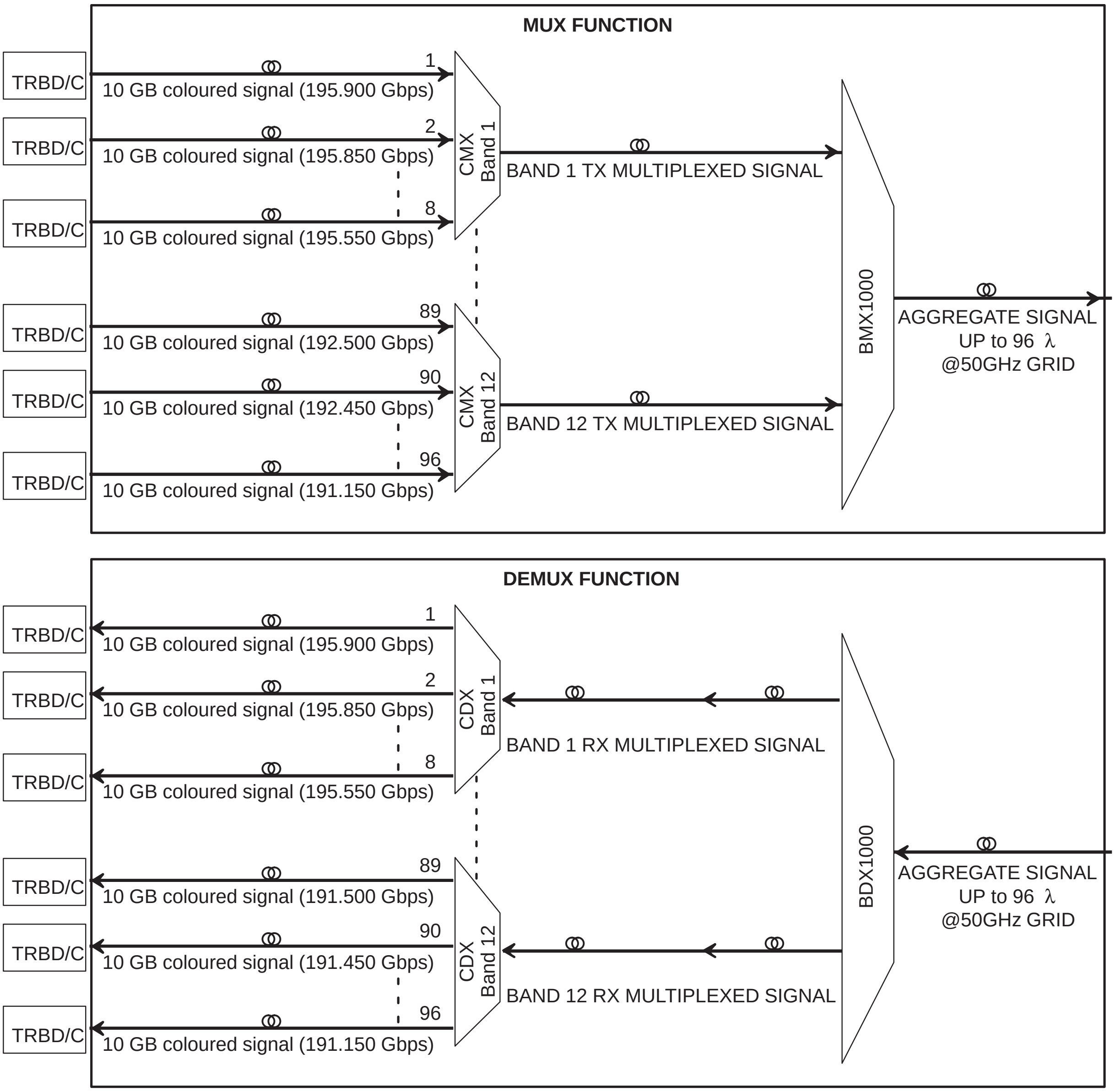
The role of this function is (see Figure 71. on page 133 and Figure 72. on page 134):

- **Optical multiplexing: ingress direction** (from client to DWDM line):
  the up to 96 coloured wavelenghts coming from the transponders, are firstly multiplexed by a max. of twelve Channel Multiplexer/DemultipleXers; each CMDX is able to multiplex 8 wavelengths (a band) providing an output signal forwarded to the Band Multiplexer/DemultipleXer. The BMDX multiplexes the twelve input signals to provide the aggregate output signal (made up of 96 channels) that has to be sent to the line, by means of the (optional) line amplifiers

- **Optical demultiplexing: egress direction** (from DWDM line to client):
  the aggregate signal coming from the line, by means of the optional line amplifiers, is firstly demultiplexed by the BMDX, providing up to twelve output signals (twelve different bands) forwarded to the appropriate (up to twelve) CMDX. Then each CMDX demultiplexes the input signal providing eight output coloured wavelenghts, forwarded to the relevant transponders.

The mux/demux sub–system has a scalable architecture based on a per–band multiplexing scheme, with 8–channel granularity. The advantage of this approach is that the number of multiplexing boards can be optimized according to the needed system capacity. Hence, starting from the minimum configuration, made up of one BMDX and one CMDX with the relevant tranponders, additional boards (CMDX and transponders) can be installed later on to increase the channel count, without affecting the existing traffic.

MUX/DEMUX SUB–SYSTEM

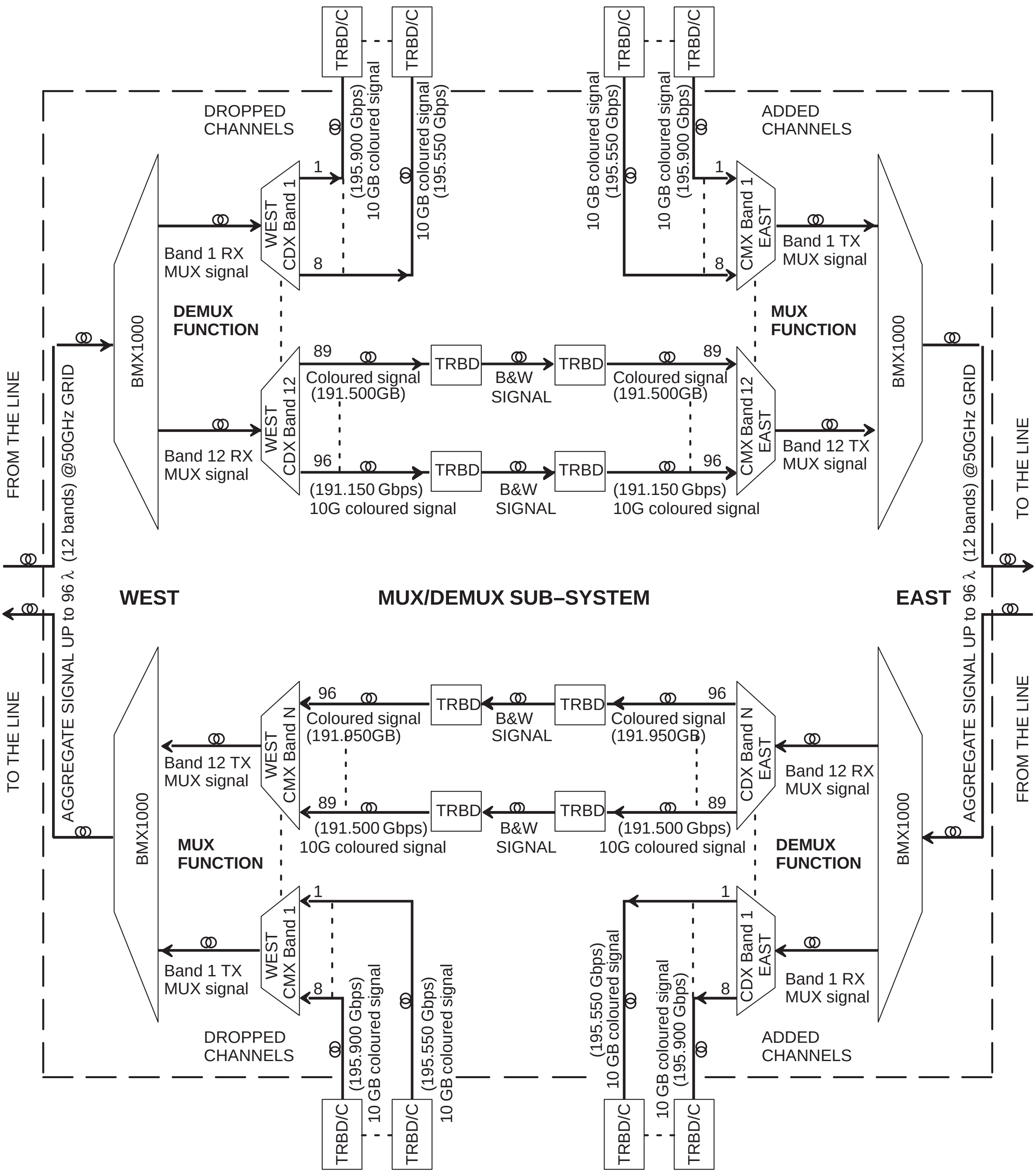


CMX AND CDX STAND FOR THE MUX (CMX) AND DEMUX (CDX) FUNCTIONS OF THE CMDX
BMX AND BDX STAND FOR THE MUX (BMX) AND DEMUX (DDX) FUNCTIONS OF THE BMDX

THIS FIGURE IS RELATED TO THE LINE TERMINAL/B–TO–B TERMINAL CONFIGURATION (WITH BMDX1000 USING AND 8–Channel per BAND). THE OADM REPEATER IS SIMILAR, WITH BMDX1100 USING AND A MAX OF 7–Channel per BAND .

BY CONNECTING THE OCP EQUIPMENT TO THE TRANSPONDERS, IT IS POSSIBLE TO SEND THE SIGNAL TOWARDS TWO DIFFERENT PATHS, PROVIDING THE 1+1 OPTICAL CHANNEL PROTECTION IN LINEAR LINKS

Figure 71. Mux/Demux sub–system in Line Terminal configuration



CMX AND CDX STAND FOR THE MUX (CMX) AND DEMUX (CDX) FUNCTIONS OF THE CMDX
BMX AND BDX STAND FOR THE MUX (BMX) AND DEMUX (DDX) FUNCTIONS OF THE BMDX

THE NON–ADDED/DROPPED CHANNELS (BAND N IN FIGURE) ARE 3R REGENERATED

BY CONNECTING THE OCP EQUIPMENT TO THE TRANSPONDERS, IT IS POSSIBLE TO SEND THE SIGNAL TOWARDS TWO DIFFERENT PATHS, PROVIDING THE 1+1 OPTICAL CHANNEL PROTECTION (OPTICAL–SNCP)

Figure 72. Mux/Demux sub–system in back–to–back terminal configuration

The **Mux/Demux sub–system in OADM Repeater configuration** is similar to the back–to–back Terminal one, except for the following points

- the BMDX used is the BMDX1100 (Band OADM)
- a max. of 7 channels can be multiplexed/demultiplexed by each CMDX
- a max. of 77 channels (11 bands) can be sent/received to/from the line, per each side (it is mandatory to keep one band for the ALCT in an OADM, to protect the transmission)
- the non–added/dropped channels are in complete pass–through, without any 3R regeneration

The **CMDX1010** is the 8:1 Channel multiplexer & demultiplexer, 50 GHz grid and AWG technology. The AWG devices provide the mux and demux function and the active temperature control to maintain wavelength stability.

The **BMDX1000** is the 12:1 Band Multiplexer & DemultipleXer for Line Terminal and Back–to–back application.

The **BMDX1100** is the 12:1 Band Multiplexer & DemultipleXer for Band OADM application.

3.1.2.1 1626 LM loading plan

Refer to Table 12. on page 129 for the frequency allocation plan.

Band sequence (both G.652 and G.655 fiber)

- Band 6, Band 7, Band 8, Band 4, Band 9, Band 3, Band 2, Band 10, Band 5, Band 1, Band 11, Band 12
- ALC in B5 until the band is loaded, then turned off.

Channel sequence inside each band

- G.652: from the most internal channel (i.e. the closest to 1546nm) to the most external, with 50GHz spacing
- G.655, designed for 100GHz spacing: from the most internal to the most external, with 100GHz spacing
- G.655, designed for 50GHz spacing: from the most internal to the most external, starting with 100GHz spacing, then passing to 50GHz spacing (after loading at 100GHz is complete).

Links without OADMs

- ALC can be turned off after 32 channels (100GHz loading) or 64 (50GHz loading).

Links with OADMs

- ALC cannot be removed if the traffic add/dropped at an OADM needs to be protected: Band 5 is lost
- Maximum number of channels: 7 x 11bands = 77.

3.1.3 Optical Fiber Amplification sub–system

In current release, optical amplifiers belong to 1626 LM.
The amplifiers used are LOFA11y0: they are EDFA (Erbium Doped Fiber Amplifier) aggregate amplifiers able to amplify all the Extended C–band.

Optical Amplifiers are based on a two–stage optical gain block which provides optical access between the two stages (interstage), used to insert a passive DCU (either DCF or HOM or any other technologies); if no DCU is used, an attenuator may be installed or the VOA may be tuned to perform the inter–stage loss.

The LOFA serves as
– in–line amplifier when it is used in a regenerator capacity
– terminal pre–amplifier when it is used as the front–end of an optical receiver
– post–amplifier (booster) when it boosts the output signal of a laser transmitter.

LOFAs provide up to 20 dBm output power without external pump module.
LOFAs provide connection to an external pump module to increase the output power up to 23 dBm (future rel).

The 1510 nm OSC wavelenght is extracted from the aggregate signal at the input of the first stage of the amplifier and it is added to the aggregate signal at the output of the second stage.

LOFA contains an internal VOA in order to optimize the gain flatness during the system lifetime and to avoid non–linear effects in DCF that can fill the interstage.
It is also able to automatically tune its VOA and its 1st stage output power.

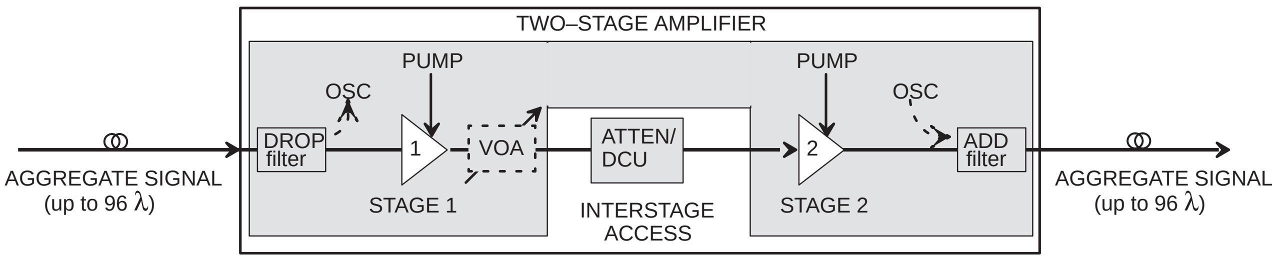
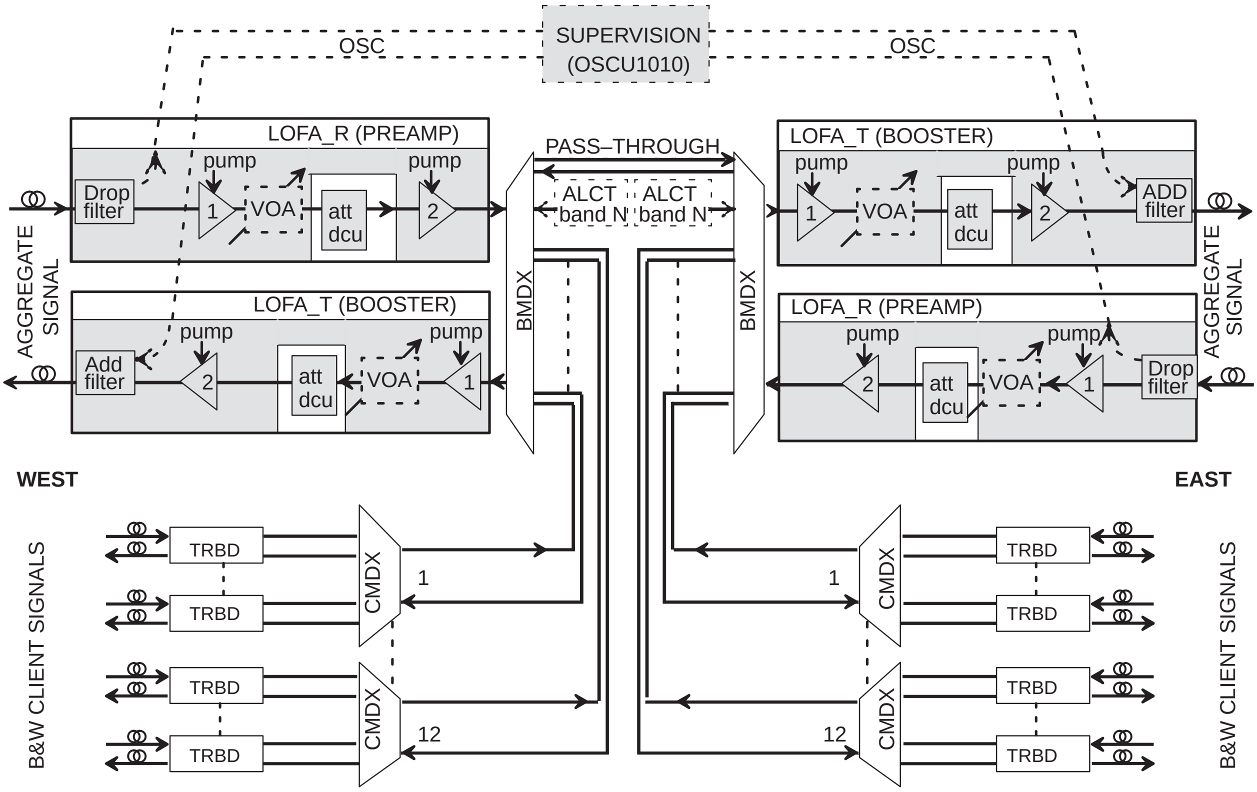


Figure 73. Generic block scheme of a 2–stage amplifier with interstage access

3.1.3.1 OFAs configuration examples

In any configuration allowed the added/dropped OSC channel has to be sent to the supervision function, performed by the OSCU1010 board.



THE LOFA DEDICATED TO AMPLIFY THE MULTIPLEXED SIGNAL THAT HAS TO BE SENT TO THE LINE, HAS TO BE CONFIGURED AS A BOOSTER

THE LOFA DEDICATED TO AMPLIFY THE SIGNAL RECEIVED FROM THE LINE THAT HAS TO BE DEMULTIPLEXED, HAS TO BE CONFIGURED AS A PRE–AMPLIFIER

THIS FIGURE REFERS TO THE OADM REPEATER. THE BACK–TO–BACK TERMINAL IS SIMILAR; THE ONLY DIFFERENCE IS THAT 3R REGENERATED CHANNELS ARE PROVIDED INSTEAD OF PASS–THROUGH CHANNELS.

Figure 74. Optical amplification in back–to–back / OADM configuration

See Figure 75. on page 138.
A Line Repeater is made up of two LOFAs in In–Line Amplifier configuration.
If no DCU are used, an attenuator may be installed or the VOA may be tuned to perform the inter–stage loss.

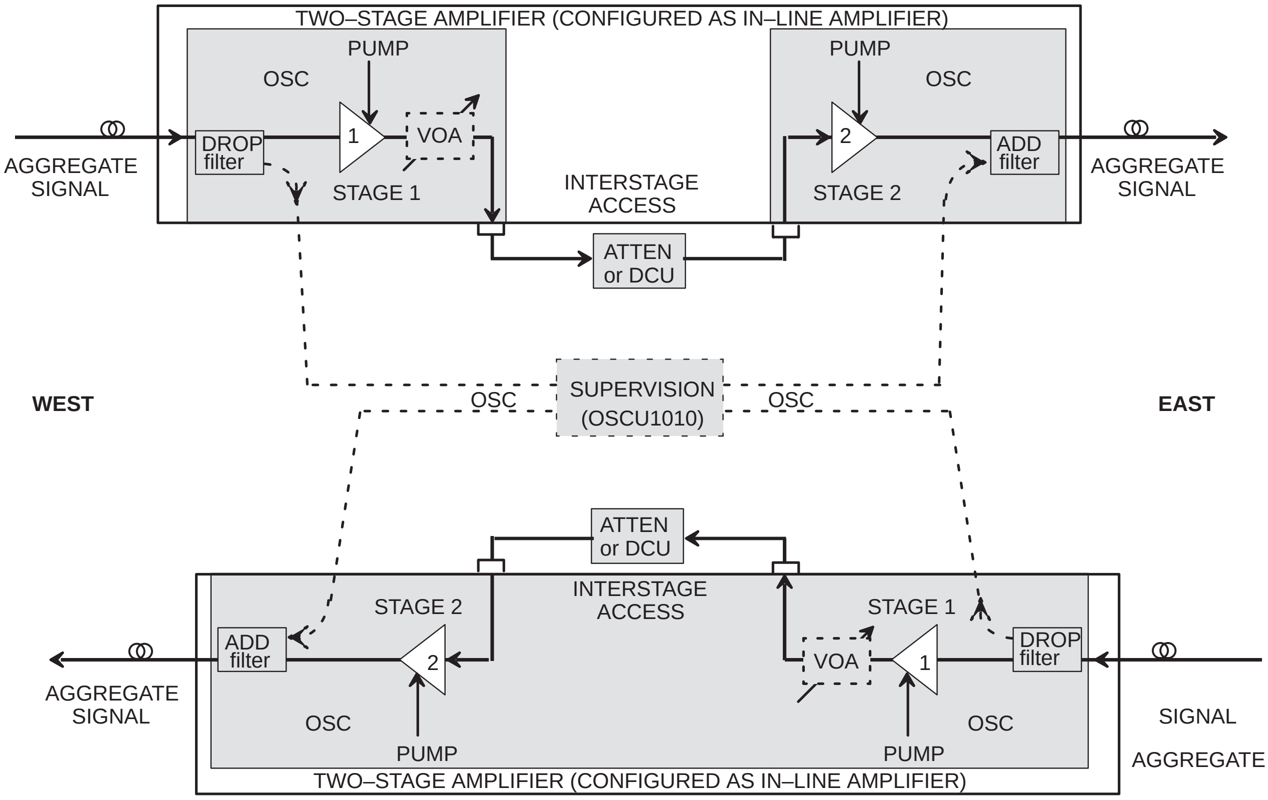
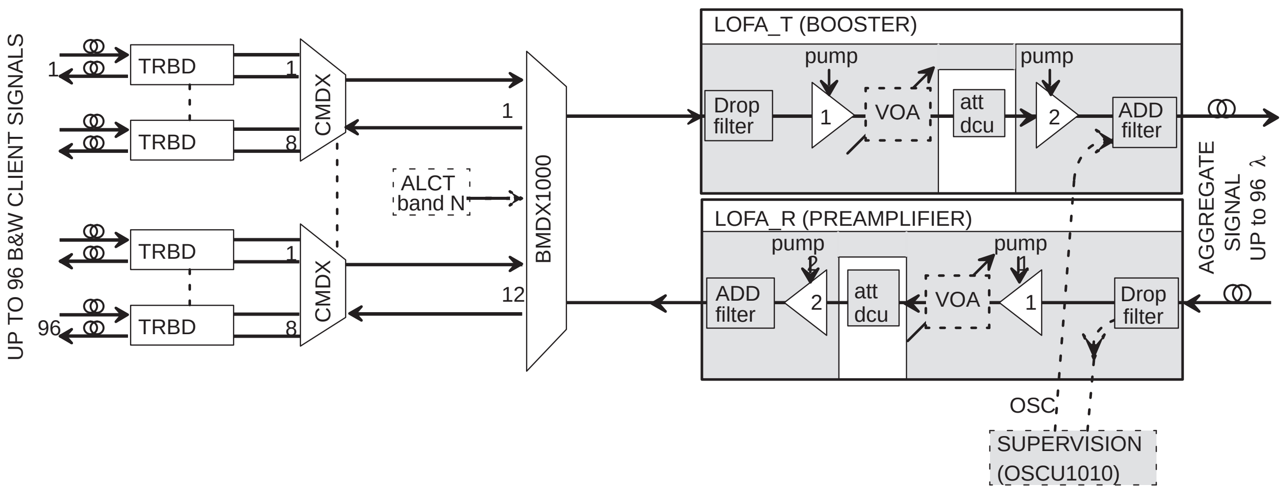


Figure 75. Optical amplification in Line Repeater configuration



THE LOFA DEDICATED TO AMPLIFY THE MULTIPLEXED SIGNAL THAT HAS TO BE SENT TO THE LINE, IS CONFIGURED AS A BOOSTER.
THE LOFA DEDICATED TO AMPLIFY THE SIGNAL RECEIVED FROM THE LINE THAT HAS TO BE DEMULTIPLEXED, IS CONFIGURED AS A PRE–AMPLIFIER.

Figure 76. Optical amplification in Line Terminal configuration

3.1.4 Optical supervisory channel (OSC) sub–system

Refer to Figure 78. on page 140.
The optional out–of–band Optical Supervisory Channel allows the supervision of all the NEs along the WDM path; moreover it gives some order–wires (data channel and voice channel) to the users.
From current release this function is managed by 1626 LM equipment, by means of the OSCU1010 supervision unit. This board provides two optical transmitters and two optical receivers to enable to supervise two directions.

Remotely, from a Craft Terminal or 1353 SH, it is possible to access the status of a distant NE and send commands to it by means of the OSC.
It is an optical channel containing the communication protocol with the ESCT1000 board in the 12 DCC (Data Communication Channel) bytes extracted from the OSC.
It is added/dropped in each NE along the transmission line, providing a communication link within the system. In this way the external DCN, necessary to connect the WDM system to the NMS, can reach any NE, receiving the supervision information concerning the whole transmission path through the OSC.

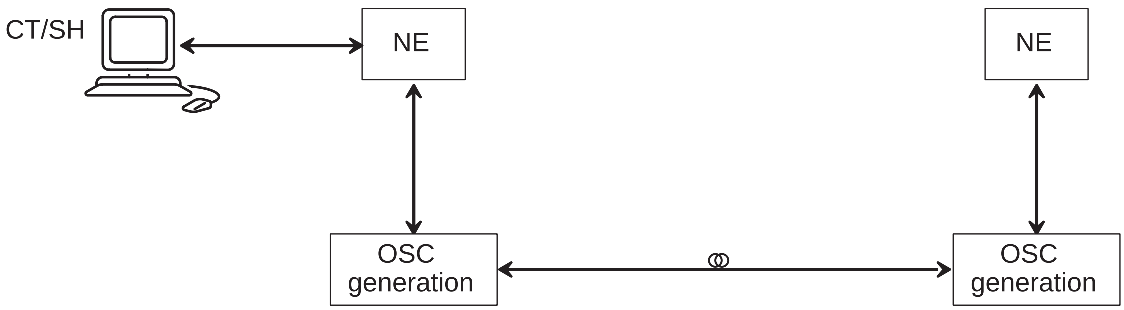


Figure 77. Remote supervision through OSC

The OSC is transported over a 1510 nm extra–band wavelength with a 4.864 bit rate being the result of the multiplexing of two 2.048 Mbps streams: the 2 Mbps supervision frame and the 2 Mbps User Data Channel (for customer needs; it will be provided in future release).

The supervision channel is
- added to the aggregate optical signal at the output of the terminal equipment, after the booster (input of the WDM line),
- terminated in each OADM, back–to–back terminal or repeater (extracted before the preamplifier/1st stage amplifier, from the optical signal received from the line, and added after the booster/2nd stage amplifier, to the optical signal transmitted to the line)
- dropped from the received optical signal at the input of the terminal, before the preamplifier (output of the WDM line).

The optical supervisory channel holds all the information for
- in–line amplifiers management
- distant line terminal or OADM or back–to–back management
- auxiliary channels for data transmission (future rel.)
- Engineering Order Wire and voice channels (future rel.).

It also provides the support of a DCC enabling remote user–access from any site to all other sites.
The OSC conveys a supervision frame that contains a set of bytes dedicated to the telecommunication management, including provisioning and equipment configuration. In addition, the frame structure reserves some bytes for the customer specific needs.

3.1.4.1 OSC management in different network configurations

Refer to Figure 78.
LT – LT; the terminal equipments are located on the left side of the figure; two LTs can communicate through the OSC generated, launched and dropped in each NE.
LT – OADM; in figure the LT communicates with an OADM; the difference between LT and OADM is that the OADM (or B–T–B, line repeater) generates, launches and drops the OSC channel on both sides.
OADM – OADM; the communication between two OADMs is the same as between LT and OADM except for both OADMs generate, launch and drop the signal on both sides (East and West).

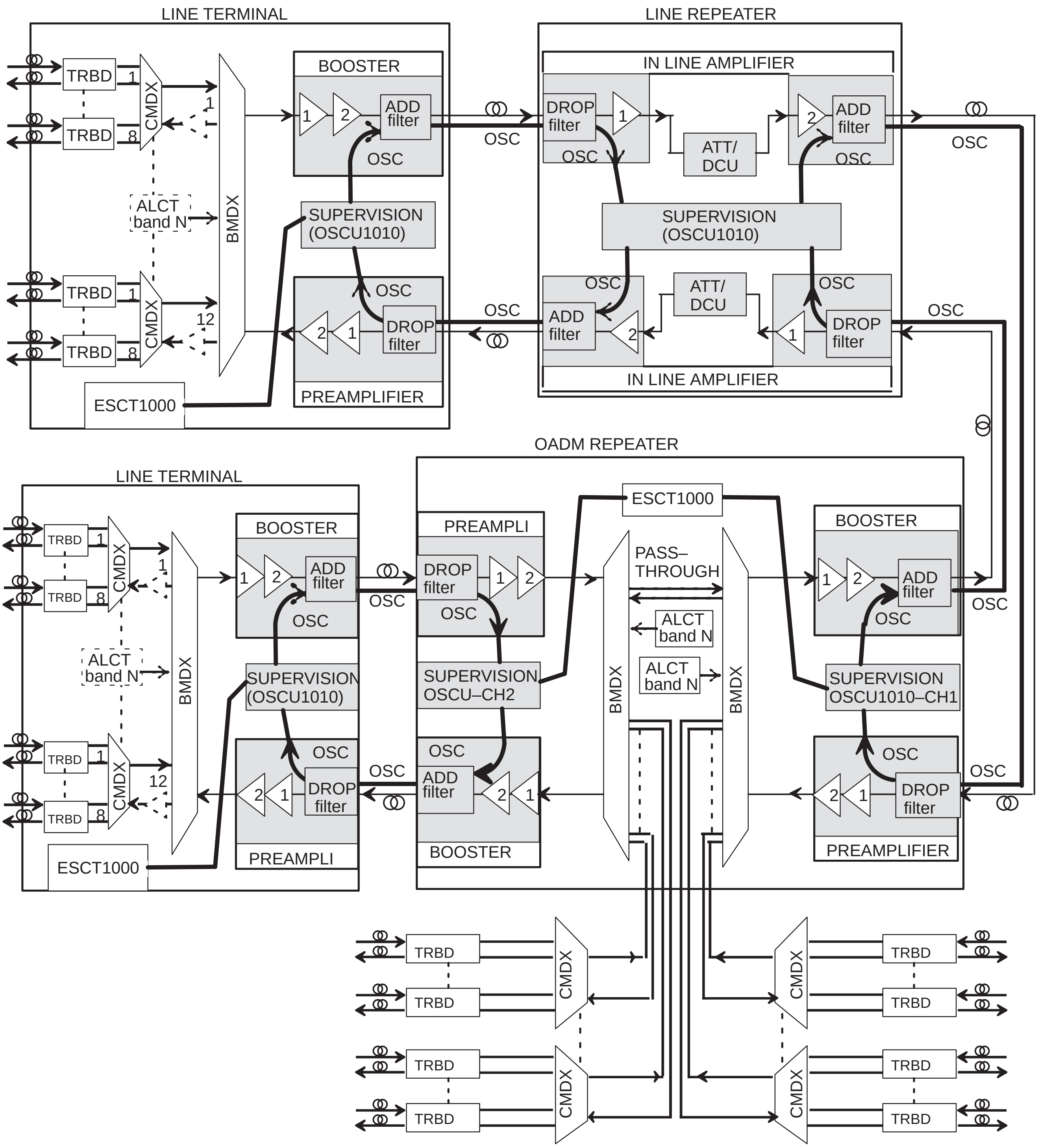


Figure 78. Example of Optical Supervisory Channel management in linear links

3.1.5 Controller sub–system

See Figure 79. on page 143 and Figure 80. The controller sub–system is based on a two–level model:
– **Equipment Controller (EC)**
– **Shelf Controller (SC).**

Equipment Controller manages Shelf Controllers.
There is one active Equipment Controller in each node and one active Shelf Controller in each shelf.

The ESCT1000 (Equipment and Shelf Controller) is the hardware platform designed to support the Equipment Controller (EC) function and the Shelf Controller (SC) function.
The ESCT1000 board is in charge of the internal management of the node. It dispatches controls received by management system to the appropriate board, check consistency between expected configuration and the actual one and finally reports alarms, performance counters and measurements.
When the board is located in the master shelf, both functionalities are operational and active
When the board is located in slave shelves, only the SC functionality is provided.

The Flash memory must be plugged only in the ESCT1000 board plugged in the master shelf.

Equipment Controller function

The **EC** supports the Q3/TL1 Network Management agent and the VHM (**V**irtual **H**ardware **M**achine).
It provides the HW resources (physical interfaces) and the SW functionalities (protocol stack) required for the communication between NE and Management system (OS, craft terminal, etc).
The EC function can be split into several domains, corresponding to the main functions performed:
– equipment – equipment type, release, address, authorized NMS addresses, rack description
– Fault Management – Alarm Severity Assignment Profiles (ASAP), Alarms correlations
– Performance Monitoring – history storage of 15 Minutes and 24hour PM data (provided by SC) in order to provide them to Network Management
– Software – software version management, software activation, software download
– Support – Filtering, logging and forwarding of events and alarms received by SCs
– Routing and Addressing – OSI/IP routing capability configuration
– Security – access control.

The Database which contains the NE configuration is saved in the PCMCIA pluggable Flash card.

Shelf Controller function

SC provides the resources to support the SW functions related to the physical machine control and management and configuration provisioning.
In a shelf all the boards are connected to the SC via the SPI bus allowing the SC processor to collect the control information of the boards (e.g.: alarms collection, remote inventory and data EEPROM reading).
The SC function can be split into several domains, corresponding to the main tasks
– Equipment – Detection of card presence with direct hardware link, Collection of remote inventory, Check that card present in slots are the expected ones, Check firmware version of the boards, Dispatching of provisioning requests received by EC to boards
– Performance Monitoring – Collection of one–second primitives used for elaboration of PM counters (15Min and 24 hours) which are then sent to EC, Collection of analog measurements (if any)
– Fault Management – Monitoring of faults : local SC faults, boards faults (equipment, communication, transmission), threshold crossing alarms
– Software – firmware download.

ALCATEL

Management buses/interfaces

F interface : available from the EC function, CT is Q3/TL1 interface for the connection to a local Craft Terminal. It is a 38.4 kbit/s serial RS232 interface with a DB9 connector.

NMS Interface: available from the EC function, NMS is the Q3/TL1 interface toward Network Management System (NMS). It is a 10 Mbps Ethernet interface with RJ45 and BNC connectors.

IS–LINK is inter–shelf link, used to realize the communication between the EC and all the SCs. It is a 10 Mbps Ethernet bus between EC and SCs located in separated shelves
In master shelf, front panel IS–LINK port is connected to EC processor (EC data to local SC are carried over ISSB bus).
In each slave shelf, front panel IS–LINK is connected to SC processor.

ISSB: it is a local serial bus allowing communication between EC and the local SC.

SPI bus (Serial Peripherical Interface): bus used between SC and boards for remote inventory, provisioning, measurements, alarms gathering, controls, ECID and check the board type against the expected one. The SC processor is master of this bus.

CPI : (Card presence interface): it is a physical link between SC and the board hosted in the same shelf. It allows to detect board presence and check its type with respect to the expected one.

Push Buttons interface, used to
- test LEDs : pushing this button on ESCT supporting EC functionality lights the LEDs of all the units of all the shelves of the NE but not on Top Rack Unit. All the possible colours of a LED are lit on whatever the previous state of the LED when this button is pressed.
  Nothing happens if ESCT only supports SC functionality (since this button is managed by EC)
- reset ESCT board
- cut off the alarms.

RA (Remote Alarms) **interface**: it is dedicated to send commands toward the rack to light up the relevant lamps.

HK (HouseKeeping) **interface**: it allows the user to manage some electrical relays and opto–couplers through CT/NMS (1353 SH) in order to remotely command some devices external to the 1626 LM NE.

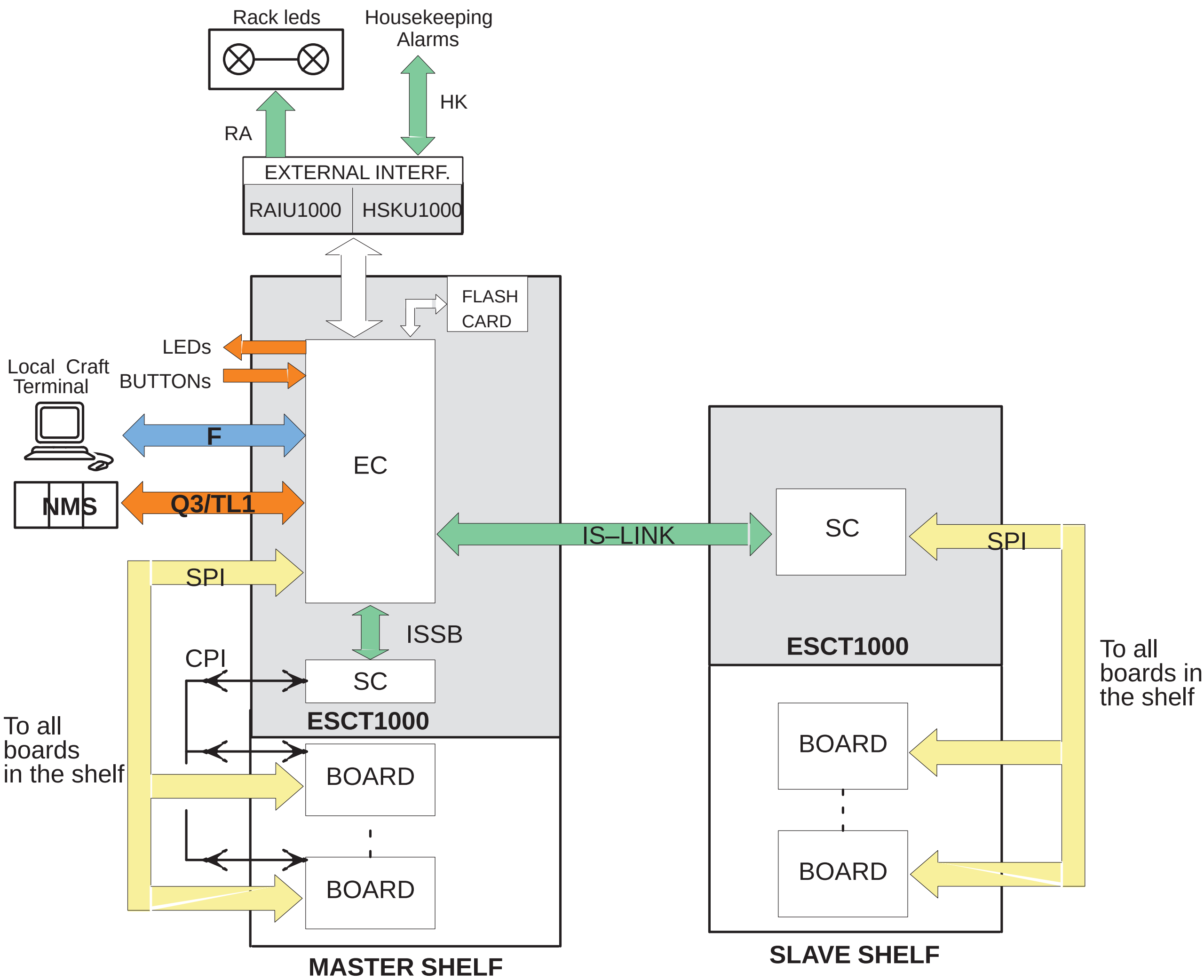


Figure 79. Controller sub–system

3.1.5.1 Example of control interfaces scheme

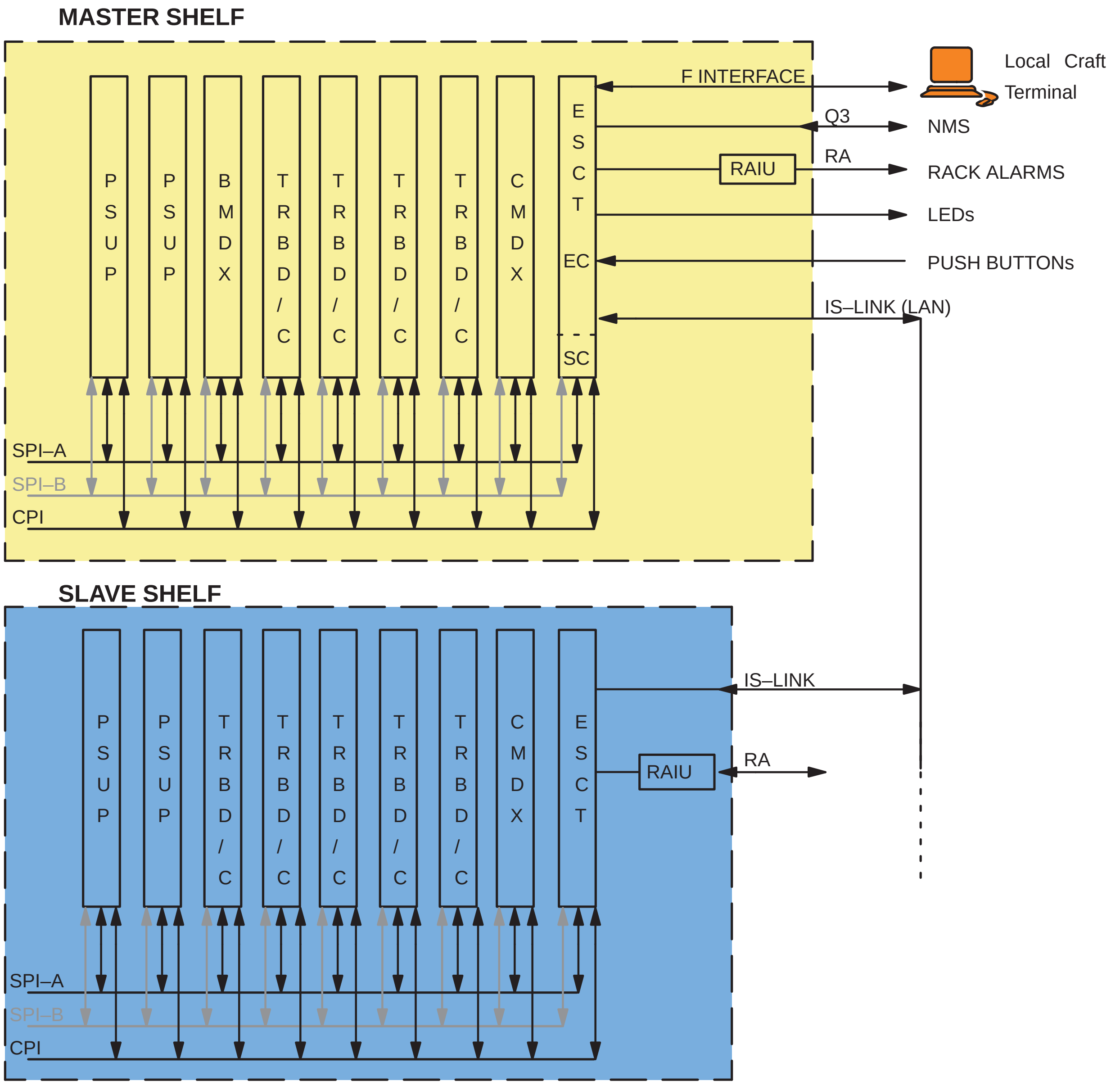


Figure 80. Example of control interfaces scheme

3.1.6 Power supply sub–system

The powering architecture is distributed: two PSUP1000 (Power SUPply unit) cards are in charge of feeding , in 1+1 protection mode, all the other cards hosted in the shelf. Each card is able to provide from the main powering, by means an internal DC/DC converter, the required power supply.

The main purposes are:
- Supply and distribute –48V/–60V filtered and protected voltage to all the boards housed in each 1626 LM shelf
- Supply and distribute +3.7V and +5.4V protected voltages to SPIDER circuitry in all the boards
- Give alarms on fault battery and voltages loss.

Functional description

Each Subrack receives powering from two DC supplies compliant with ETSI standard ETS 300 132–2, for nominal –48V or –60V supplies. Each of the two DC supplies is protected at the top of the rack by appropriate circuit breakers prior to being fed to each subrack within the rack.
Each of the two supplies (–48V_A and –48V_B) feed one of the two PSUP1000 plugged in each subrack.
The PSUP1000 units provide the necessary filtering and surge suppression of the –48V or –60V input DC supply, prior to distributing the power supply to the units within the subrack.
The filtered –48V/–60V supply is fed from each power supply unit to the backplane, the power rails are then combined using sharing diodes on each card supplied with the –48V/–60V power supply.
Under normal operating conditions the load required by the unit from the –48V/–60V supply is shared approximately equally between the two PSUP1000 inputs.
At the –48V/–60V input interface of each unit, appropriate fuses shall be used to protect the card.
The normal input voltage range of the power supply module is either:
- $-40{,}5\ V < -48\ V < -57{,}0\ V$
- $-50{,}0\ V < -60\ V < -72{,}0\ V$.

A battery return path to each of the two –48V/–60V supplies from the units to the power supplies is provided.

On each PSUP1000 unit, a 3.7V (V3A & V3B) power rail and a 5.4V (V5A & V5B) power rail are derived from its filtered –48V/–60V power supply and from the filtered –48V/–60V of the other PSUP1000. The 3.7V and 5.4V power rails are then distributed to all cards in slots 1 to 49 of the subrack.
The 3.7V power rails (V3A & V3B) are combined (using diodes) in the unit to provide a single 3.3V power supply, that will be fused within the unit. This is to prevent a fault condition of this power rail within the unit from causing a fault condition on the backplane V3A/B power supply rail to the other units.
The same occurs for the 5.4V power rails (V5A & V5B), providing a 5.0V power supply.

Figure 81. on page 146 shows the equipment power supply scheme.

Abnormal service range

The 1626 LM equipment operating at –48 V is not damaged if subjected to the following voltage range : 0 V to –40,5 V and –57 V to –60 V.
When the equipment operates at –60 V, is not damaged if subjected to the following voltage range : 0 V to –50 V and –72 V to –75 V.
Therefore, the equipments accepting either a –48V or –60V power supply input, has to operate within specification over the voltage range of –40.5 to –72.0V and shall not suffer any damage when subjected to an input voltage in the range of 0V to –40.5V and –72.0V to –75.0V.

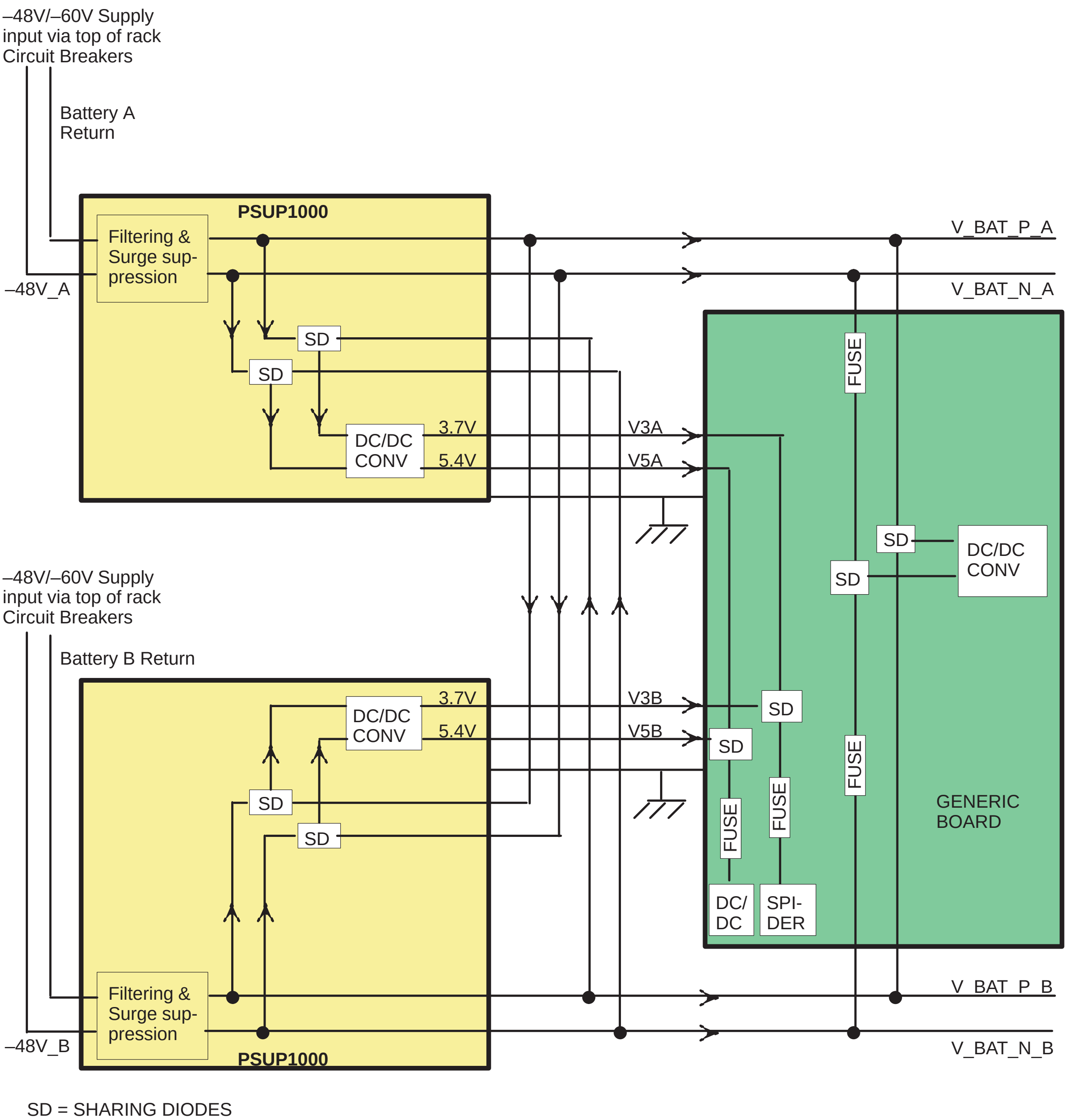


Figure 81. 1626 LM – equipment power supply scheme

3.1.7 Protection sub–system

Functionality provided in future release. The optical protections are managed by means of an additional equipment, named OCP, able to provide to a generic host tributary system both linear and ring optical channel (OCh) protections. The OCP is located between the client interface and the transponder cards and it is made up of optical splitters and optical switches.
For more details see the OCP handbook.

Optical Channel (OCh) protection in ring networks

See Figure 82. on page 147. The channel protection applied to a ring topology is the Optical SNCP (future rel.).
By means of a passive 1x2 splitter (belonging to OCP), the client signal is split towards two different transponders (protected and protecting), each one transmitting in one direction (west or east). In this way the WDM signal is transmitted on the two arms of the ring (see also Figure 83. on page 148).
In reception, the optical signal to be returned to the client is selected by the 1x2 optical switch (inside the OCP) from the two diversely routed signals, and then delivered to the host system.
In normal operating conditions, the Protected Transponder is “In Service” and it is connected through the optical switch.
When a failure occurs on the working path, the system switches on the signal of the protecting path.
The switching criterion is the LOS and the optical switching time is as quick as tens of milliseconds.
In a ring network, the Sub–Network Connection Protection (SNCP) at optical channel level can be provided either in ”back–to–back” terminals or in OADM configuration.

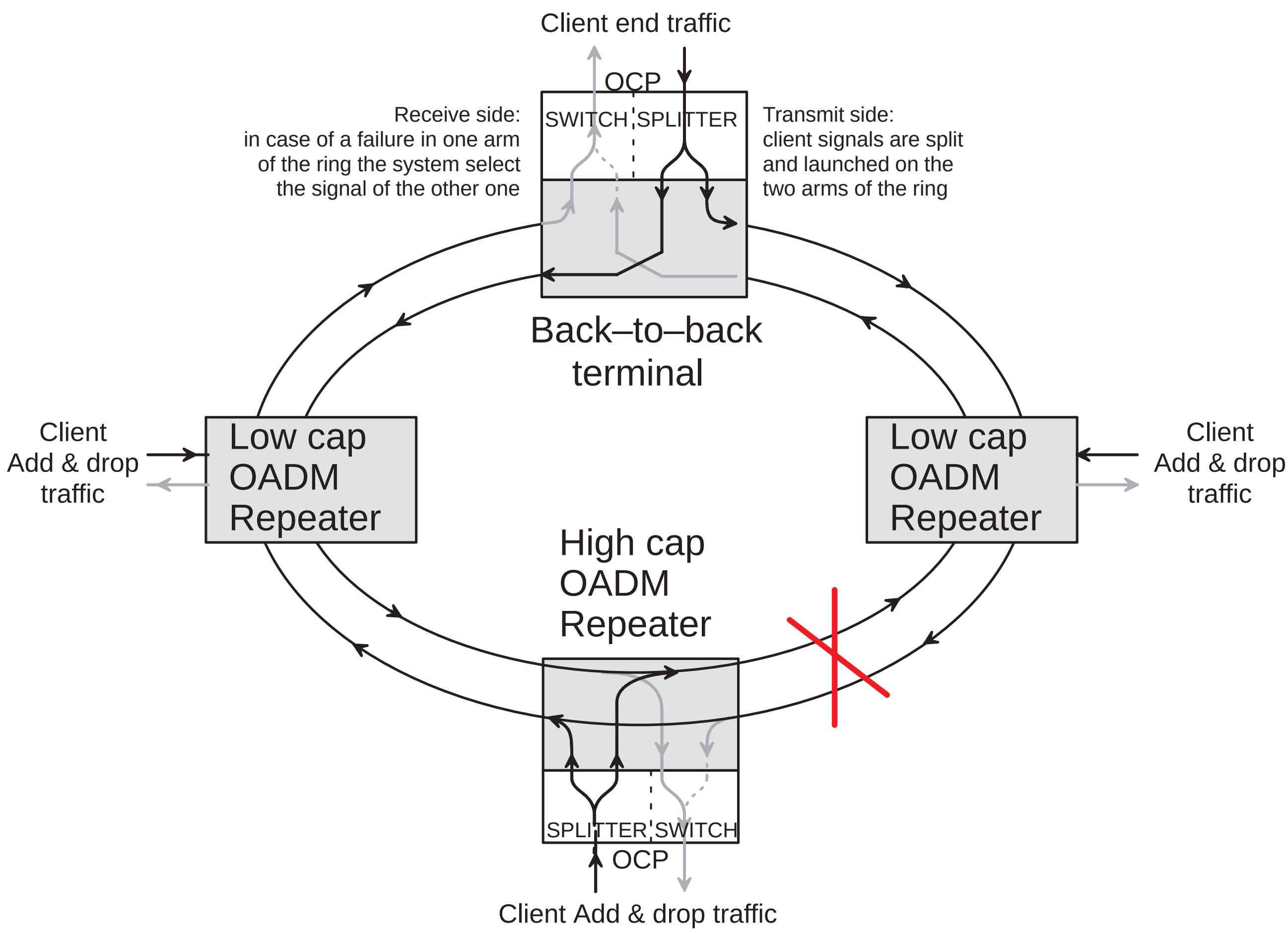


Figure 82. Channel level protection in a ring network

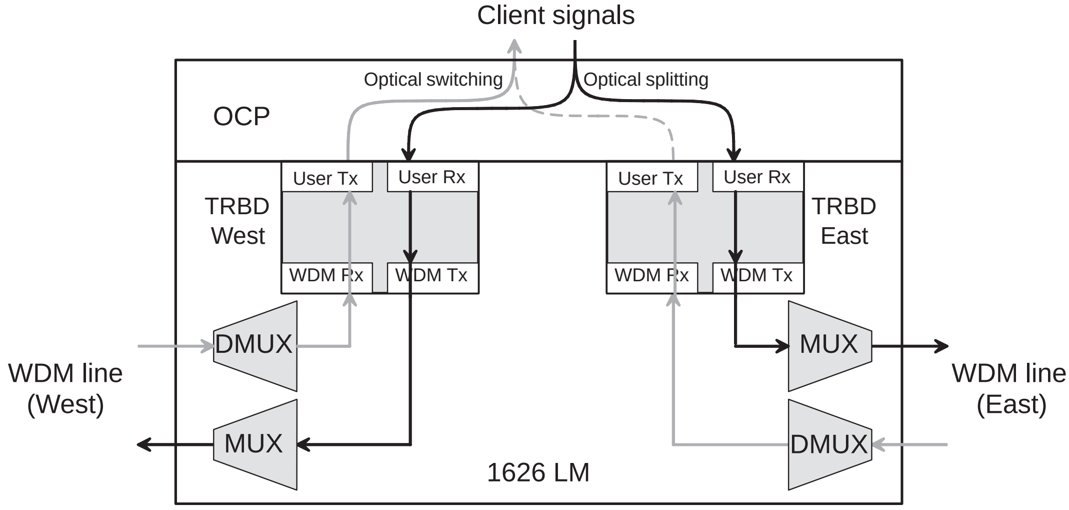


Figure 83. O–SNCP principle

Optical Channel (OCh) protection in linear networks

See Figure 84. on page 148. By means of a passive 1x2 splitter (belonging to OCP), the client signal is split towards two different transponders (protected and protecting), one transmitting over the working path, the other transmitting over the protecting path; see also Figure 83. on page 148.
In reception the optical signal to be returned to the client is selected by the 1x2 optical switch (OCP) from the two diversely routed signals, and then delivered to the host system.
In normal operating conditions, the Protected transponder is “In Service” and it is connected through the optical switch.
When a failure occurs on the working path, the system switches on the signal of the protecting path.
The protection is triggered by the Loss of Signal (LOS).
The Optical Channel (OCh) protection in linear links applies between two Line Terminals or between a Line Terminal and an OADM Repeater.

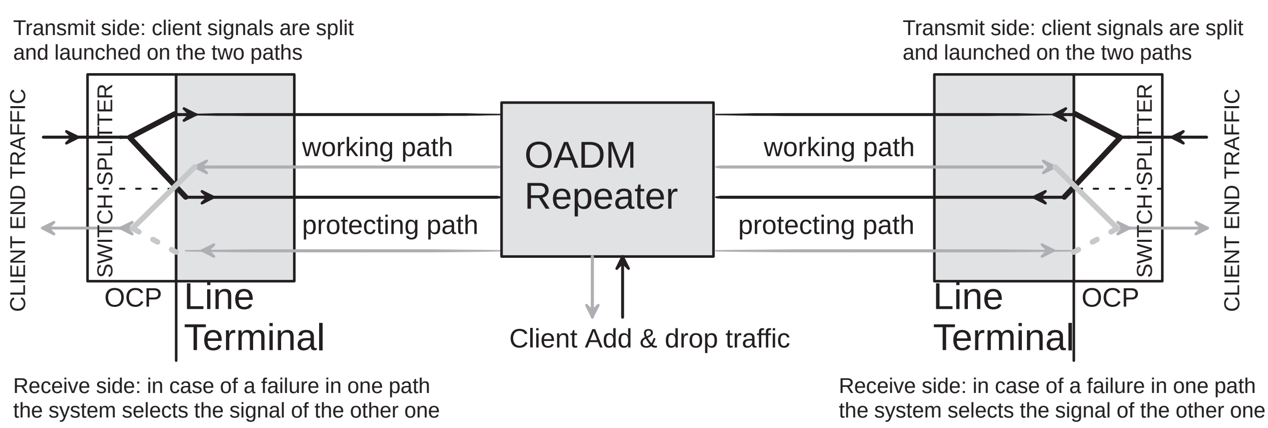


Figure 84. Channel level protection in a Linear network

3.1.8 1626 LM R.2.0 Performance Monitoring sub–system

Performance Monitoring consists of monitoring the quality of the signal flowing through selected Performance Monitoring Points, accumulating information during fixed time windows (granularity periods: 15min or 24h) and providing consistent information to the management interface (end–to–end monitoring).

When PM is activated, for each PM Point, the following processes are automatically performed

- Continous monitoring by transmission boards of the quality of the signal flowing through the PM Point and generation of raw PM information, known as 1s PM primitives (1s stands for 1 second)
- Correlation between 1s PM primitives by SC, with periodic collection of 1s PM primitives and accumulation of corresponding PM counters (PM events) during the current monitoring period.
  N.B. PM primitives are raw information, internally used, but not made available at NMS; PM counters are the result of correlations among PM primitives and their values are made available at NMS.
- Generation of PM current data related to the current monitoring period (15min / 24h), based on PM counters accumulated during the current monitoring period
- Comparison of PM counters of the current monitoring period with related PM Threshold profile (TCA)
- Generation of PM history data, with storing of PM information related to past 15min / 24h periods

From the management interface, it is possible to manage PM data (clear PM counters, deactivate Performance Monitoring...) and PM Thresholds, used to generate TCA (profile assignment/modification...).

Performance Monitoring Points on transmission boards

PM Points are characterized by the following parameters:

- monitored “side”, which can be:
  - WDM if monitoring is performed on information received from WDM side (WDM —> BW)
  - B&W if monitoring is performed on information received from B&W side (B&W —> WDM)

- monitored “end”, which can be:
  - Near End if monitoring is related to the quality of the received signal

- monitored “layer”, which can be:
  - on TRBD
    - FEC2 based on FEC decoder info (Corrected Errors, Uncorrected Blocks) at 10Gbps
    - SDH10G based on information contained in SDH Regenerator Section 10G overhead and specific ETSI processing
  - on TRBC
    - FEC2 based on FEC decoder info (Corrected Errors, Uncorrected Blocks) at 2.5Gbps
    - SDH2.5G based on information contained in SDH Regenerator Section 2.5G overhead and specific ETSI processing

For each PM Point it is possible to activate monitoring with 15min or 24h (or both at the sa0me time) granularity.
The following table summarizes the combination of monitored side/end/layer, supported in R.1.2
The information of monitored side/end/layer is encoded in the PM Point Mnemonic with the following rule:
p<Near / Far end>_<layer>_<side>
E.g.: **pN_FEC2_WDM** means **p**erformance point **N**ear end, on layer **FEC2**, on signal received from **WDM**

Table 13. Boards and supported Performance Monitoring Points

PM Point Mnemonic	1626 LM ETSI	Notes
pN_FEC2_WDM	TRBCwxyz TRBDwxyz	10G preOTN/UNI/NNI
pN_SDH10G_WDM	TRBDwxyz	10G preOTN/UNI
pN_SDH10G_BW	TRBDwxyz	10G preOTN/UNI
pN_SDH2.5G_BW	TRBCwxyz	4x2.5G preOTN/UNI

3.1.8.1 1626 LM PM working mode in Rel.1.2

The Performance Monitoring sub–system performs the end–to–end quality–of–service monitoring of each individual wavelenght, all along its path. Performance monitoring is available:

– CLIENT side, at the User Rx access in order to monitor the client incoming (near end) signal; in this case PM (SDH type) is based on B1 and J0 n.i.m. and Treshold Crossing Alarm based on B1 errors count (J0 n.i.m. in future release)
– WDM side, at the WDM Rx access in order to monitor the WDM incoming (near end) signal and its transmission through the WDM network; in this case PM and Treshold Crossing Alarm are based on FEC corrected/uncorrected errors.

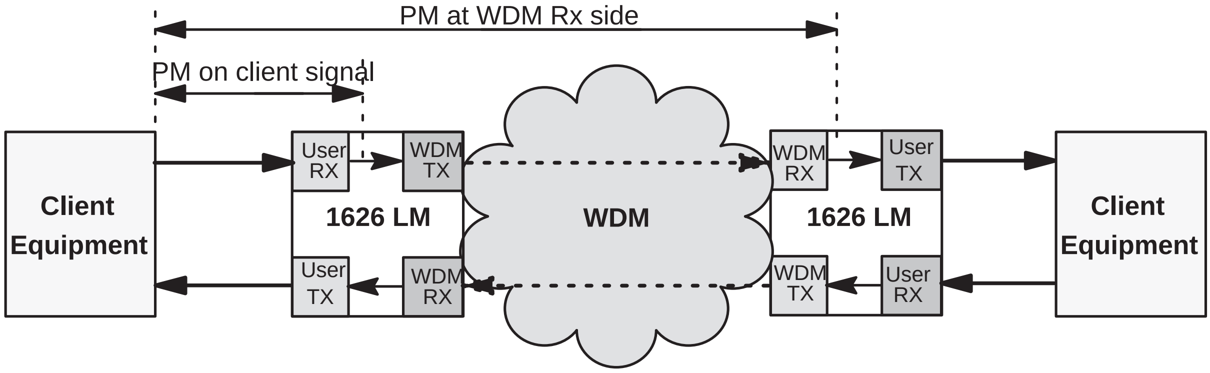


Figure 85. Example of possible monitored sections

As already stated, the system monitors 1s PM primitives and then generates PM counters, briefly described in the following.

PM counters (PM events) accumulation by the Shelf Controller for 15min/24h granularity period

Starting from 1s PM primitives collected with the polling mechanism, SC evaluates corresponding PM counters (also known in standards as PM events) increments, that are accumulated over the current monitoring period to which they are related (15min or 24hours) for PM purposes (Current Data generation).

FEC2 Near End PM (BW, WDM)

– **BEC** (**B**ackground **E**rrors **C**orrected): FEC2 = sum of (pN_FEC2_CE occurred outside SCS) / 512; FEC1 = sum of (pN_FEC2_CE occurred outside SCS) / 128
– **CS** (**C**orrected **S**econds): not meaningful; fixed value = 0
– **SCS** (**S**everely **C**orrected **S**econds): sum of seconds with pN_FEC2_CE =0xFFFE or Unit Missing
– **BBU** (**B**ackground **B**locks **U**ncorrected) : sum of pN_FEC2_UB occurred outside SUS
– **US** (**U**ncorrected **S**econds): not meaningful; fixed value = 0
– **SUS** (**S**everely **U**ncorrected **S**econds): sum of seconds with pN_FEC2_UB=0xFFFE or Unit Missing

SDH 2.5G, 10G Near End (WDM & BW) specific PM processes:

– **BBE** : **B**ackgroung **B**lock **E**rrors: is the sum of errors detected on the SDH frame, during the monitored period (15min or 24h), except for the errors occurred during SES seconds
– **ES** : **E**rrored **S**econds: is the number of seconds with at least one error in SDH frame, or SES seconds, occurred during the monitored period (15min or 24h)
– **SES** : **S**everely **E**rrored **S**econds : is the number of SES seconds occurred during the monitored period; a second is declared SES if the number of errors detected on the SDH frame is more than 2400, or if during the second the SDH frame has been lost (LOF).
  Note: the errors on SDH frame are detected using BIP8 (Bit Interleaved Parity) over B1 byte of the SDH frame.

PM current data management

Performance Monitoring on a given PM Point can be activated on either 15–minute or 24–hour (or both at the same time) granularity.

During a monitoring period, PM information (counters, elapsed time, etc.) is continuously updated and can be managed from management interface. At the end of the monitoring period, PM data (counters, elapsed time, etc.) are reset and a new monitoring period begins.
At the end, sixteen 15min and one 24h history data are stored in the NE.

Threshold Crossing Alarms (TCA)

15min and 24h PM counters are compared to provisionable thresholds, in order to generate TCA.
There are two possible mechanisms that can be used to generate TCA:

– Single Level Threshold Crossing: a threshold level is associated to each counter of an activated PM point; TCA is raised each time the threshold is crossed by any counter, during an accumulation period
– Dual Level Threshold Crossing: two threshold levels are associated to each counter of an activated PM point: the Set and the Reset ones. TCA is generated each time the Set (high) threshold is crossed during an accumulation period. TCA is reset (clear) at the end of a subsequent accumulation period in which the counter that generated TCA is lower than or equal to the Reset (low) value.

Default thresholds for QoS alarms

The default values of set and reset thresholds are given in the following tables.

Table 14. RS default threshold data values

Threshold Data Id	15 min Set Threshold			15min Reset Threshold			24 hours Threshold		
	BBE	ES	SES	BBE	ES	SES	BBE	ES	SES
3	24000	50	10	200	5	0	–	–	–
2, 205000, 21500, 22500, 23500, 245000	–	–	–	–	–	–	36000	150	15
20000, 21000, 22000, 23000, 24000	24000	50	10	–	–	–	–	–	–

Alarms

This section lists all the alarms that can be generated by the objects belonging to the performance monitoring domain.
For TCA, the ASAP mechanism to set the alarm severity is not used. In order to set the alarm severity the reference object is threshold Data, in which the alarm severity can be configured setting the severity Indication field of the counterThreshold Attribute List attribute. The default severity is Warning for all the TCA.

Table 15. Performance Domain alarms

Alarm	Probable cause	Specific Problem	Threshold Info	TP (direction)
TCA_BBE	thresholdCrossed	bBE oid	– BBE counter – BBE value	rsCurrentData rsCurrentDataTR
TCA_ES	thresholdCrossed	eS oid	– ES counter – ES value	rsCurrentData rsCurrentDataTR
TCA_SES	thresholdCrossed	sES oid	– SES counter – SES value	rsCurrentData rsCurrentDataTR
TCA_SCS	thresholdCrossed	sCS oid	– SCS counter – SCS value	ochCurrentData ochCurrentDataTR
TCA_SUS	thresholdCrossed	sUS oid	– SUS counter – SUS value	ochCurrentData ochCurrentDataTR
TCA_BEC	thresholdCrossed	bEC oid	– BEC counter – BEC value	ochCurrentData ochCurrentDataTR
TCA_BBU	thresholdCrossed	bBU oid	– BBU counter – BBU value	ochCurrentData ochCurrentDataTR

3.1.9 Remote inventory sub–system

See Figure 86. on page 153. The Remote Inventory function permits the operator to retrieve information about any card present on the equipment.
The available information is: construction date, code number, maker name, board identification, etc. (see details in the Operator Handbook).
The Remote Inventory function is present in all the cards.

The relevant data are transported by a duplicated serial link named SPI (A and B), that connects all cards of the equipment with the SC. The SC is the master of this bus.

The SPI bus is a low speed serial communication channel, used by the SC to transfer data to/from devices (memories, I/O expanders...) placed on the equipped cards, through the backpanel. The SPIDER device provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID...) are connected permitting the Shelf Controller to acknowledge data (RI, Card type, Alarms..) from all the equipped boards.

The SPIDER block is connected with
- the remote inventory memory, to acknowledge remote inventory data
- the ECID memory, to acknowledge the board identification (and pre–setting data of the unit) information (no ECID in ESCT1000)

Further it manages the slot identifier (SID), front panel leds, and some I/O parallel ports for bord alarms gathering / measurements / controls / tunings that can be transferred to the SC by means of the SPI bus.

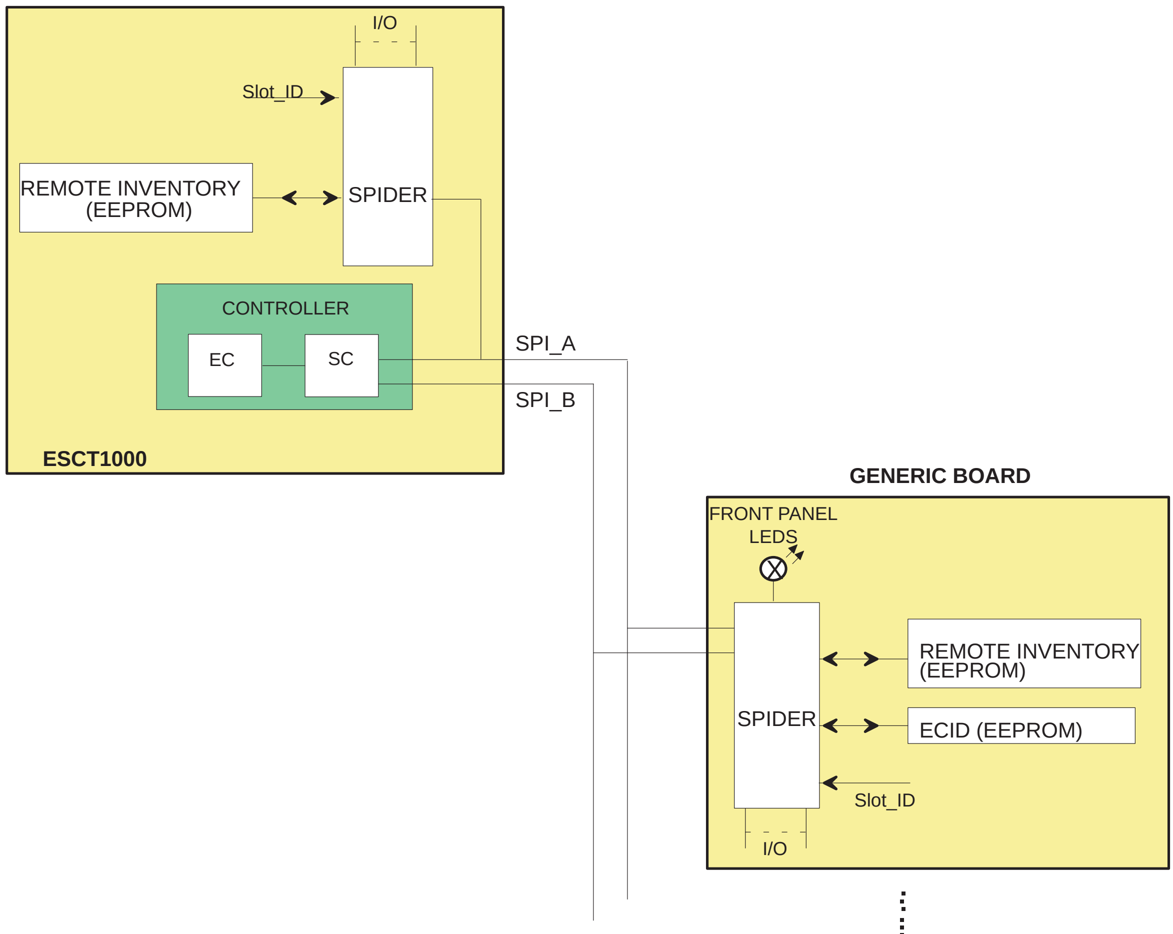


Figure 86. Remote Inventory sub–system

3.1.10 Frame structure

The G.709 standard offers a considerable quantity of service channels in the OverHead (OH) bytes of the frame. These bytes are used for section maintenance (frame aligment, network management operations, auxiliary communications,..)
For reader's convenience, the structure of some WDM frames is shown in the following pages; in particular will be further detailed the structure ot the digital domain structures.

Reference specifications: G.709.

3.1.10.1 Introduction

In the following is briefly described the G.709 frame construction (Optical Transport Hierarchy – OTH), in client to WDM direction.
This para. is mainly dedicated to the adaptation of the 10 Gbps B&W client signals (SDH/SONET...), into the WDM coloured signals. A brief description of the 2.5 Gbps B&W client signals is also given, in particular on the multiplexing structure to have the 10Gbps WDM signal.
The UNI interface is thus considered, client side.

In case of NNI, the input signals to the system is OTUk; thus, this is the starting level in the structure (no OPUk and ODUk adaptation has to be performed).

Refer to Figure 87. on page 155. The client signal or an Optical channel Data unit / Tributary Unit Group is mapped into the OPUk. The OPUk is mapped into an ODUk and the ODUk is mapped into an OTUk. The OTUk is mapped into an Optical Channel (OCh). In next para. an explanation of these mapping will be provided.
The OCh is an information structure consisting of the OCh payload with a certain bandwidth and non–associated overhead for the optical channel management. The OCh transports a digital client signal between 3R regeneration points.
The OCh is then modulated onto an Optical Channel Carrier (OCC), representing a tributary slot within the OTM. The OCC consists of the OCC Payload, assigned to a wavelength/frequency of the WDM group, and OCC Overhead, that is transported within the OTM Overhead Signal (OOS) structure.

Wavelength division multiplexing. Up to n OCCs are multiplexed into the Optical Multiplex Section (OMS) using wavelength division multiplexing. The characteristic information of the OMS consists of OMS payload and OMS overhead. The OMS overhead is transported within the OOS structure.

The Optical Physical Section of order n (OPSn) is a network layer providing functionality for transmission of a multi–wavelength optical signal on optical media of various types (e.g. G.652, G.653 and G.655 fibre). It combines the transport functionality of the OMS and OTS layer networks without their supervisory information.

The characteristic information of the Optical Transmission Section (OTS) consists of OTS payload and OTS overhead. The OTS OverHead is added to the payload to create an OTM; It includes information for maintenance and operational functions to support OTS. The OTS overhead information is contained within the OOS structure and it is terminated where the OTM is assembled and disassembled.

The Optical Transport Module (OTMn) is the information structure that is transported across the Optical Network. The OTM consists of up to **n** multiplexed optical channels and an OTM overhead signal (OOS) to support the non–associated overhead. It is the structure used to support OTS layer connections in the OTN.

The Optical Supervisory Channel (OSC) is the physical carrier outside the amplifier band providing the transport of the OTM overhead signal; it is multiplexed into the OTM using wavelength division multiplexing.

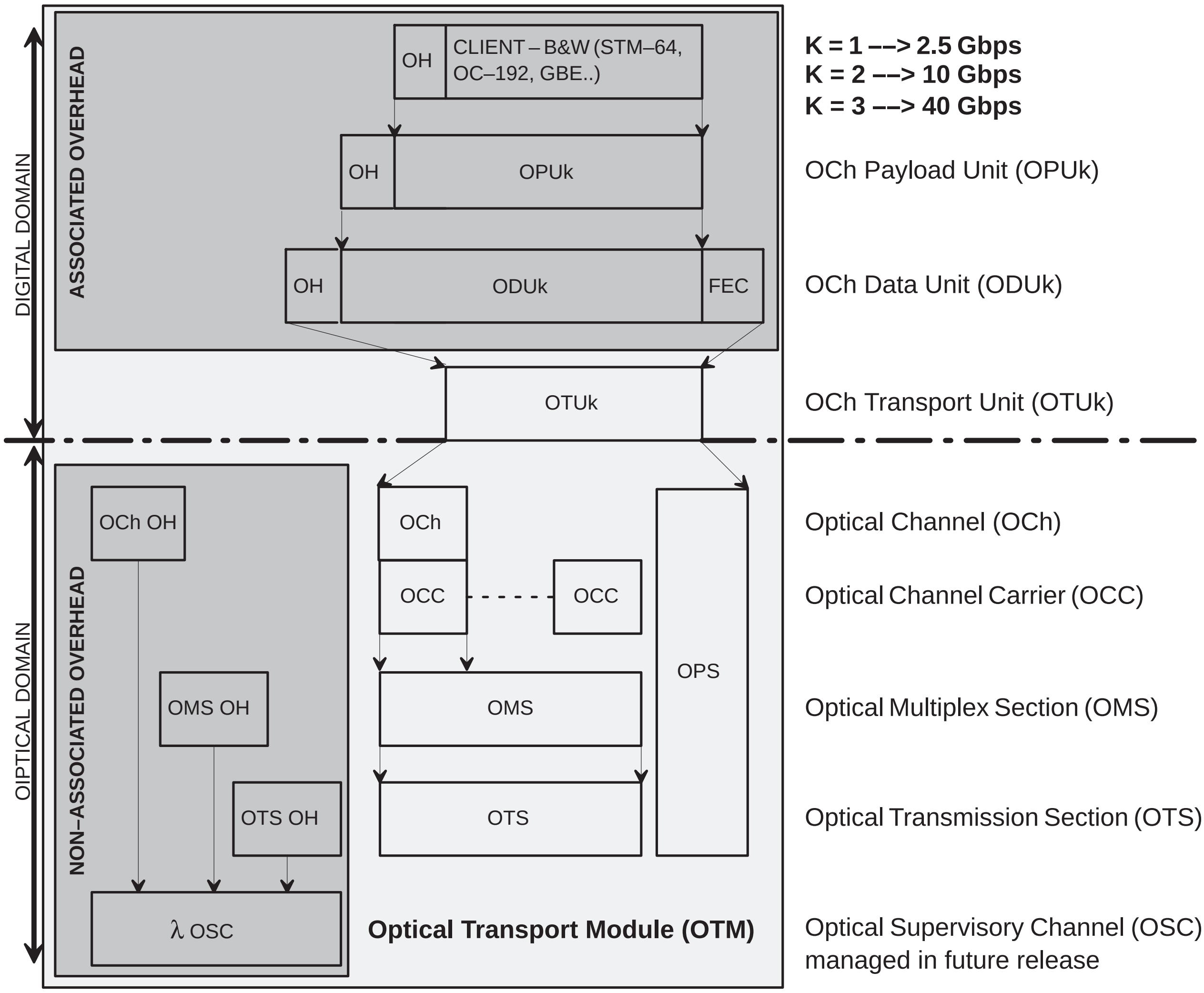


Figure 87. Optical Transport Hierarchy (OTH) frame structure

Refer to Figure 88. on page 156 where is mainly presented the multiplexing of four ODU1 signals into the OPU2 signal. The multiplexing structure is compliant to the ITU—T G709/Y.1331 recommendation.
Each (of four) B&W client signal is mapped into the OPU1. The OPU1 is mapped into an ODU1.
An ODU1 signal is extended with frame alignment overhead and asynchronously mapped into the Optical channel Data Tributary Unit 1 into 2 (ODTU12), using the justification overhead (JOH).
The four ODTU12 signals are time division multiplexed (bit interleaving) into the Optical channel Data unit Tributary Unit Group 2 (ODTUG2), after which this signal is mapped into the OPU2.
The OPU2 is then mapped into an ODU2 and the ODU2 is mapped into an OTU2.

The four incoming signals can be fully asynchronous. The stuffing overheads are inserted in order that the client signal (e.g. STM16) is fully transparently transmitted.

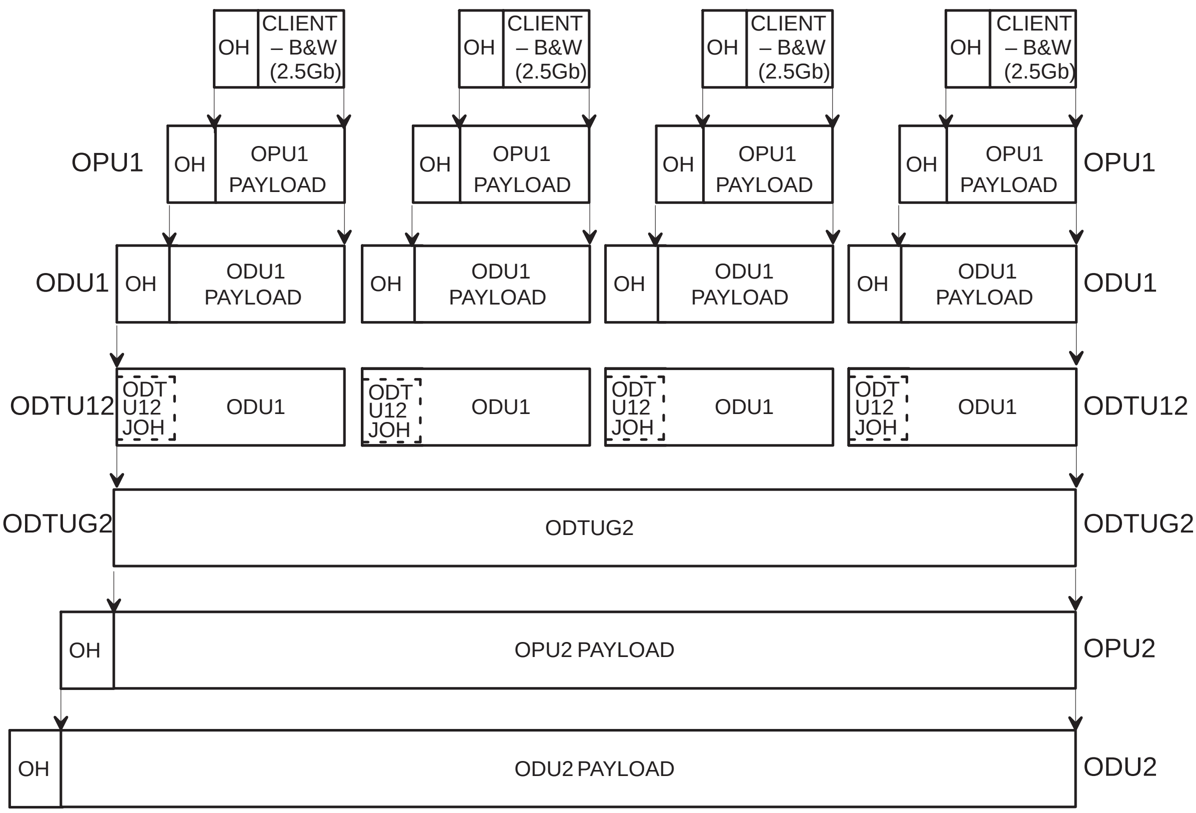


Figure 88. Multiplexing of four ODU1 into a ODU2

3.1.10.2 Optical channel transport unit (OTUk) description

The OTUk conditions the ODUk for transport over an optical channel network connection. The OTUk frame structure is completely standardized.
The OTUk (k = 1,2,3) frame structure is based on the ODUk frame structure and extends it with a forward error correction (FEC) as shown in Figure 89.
256 columns are added to the ODUk frame for the FEC and the reserved overhead bytes in row 1.
Columns 1 to 7 are dedicated to the Frame Aligment overhead.
Columns 8 to 14 of the ODUk overhead are used for OTUk specific overhead, resulting in an octet–based block frame structure with four rows and 4080 columns. The MSB in each byte is bit 1, the LSB is bit 8.
The bit rates of the OTUk signals are defined herebelow:

– OTU1 = 2.666 057 Gbps
– OTU2 = 10.709 225 316 Gbps
– OTU3 = 43.018 413 559 Gbps

The OTUk forward error correction (FEC) contains the FEC codes (RS or Super FEC or BCH).
If no FEC is used, fixed stuffing bytes (all–0s pattern) are to be used.
The transmission order of the bits in the OTUk frame is left to right, top to bottom, and MSB to LSB.

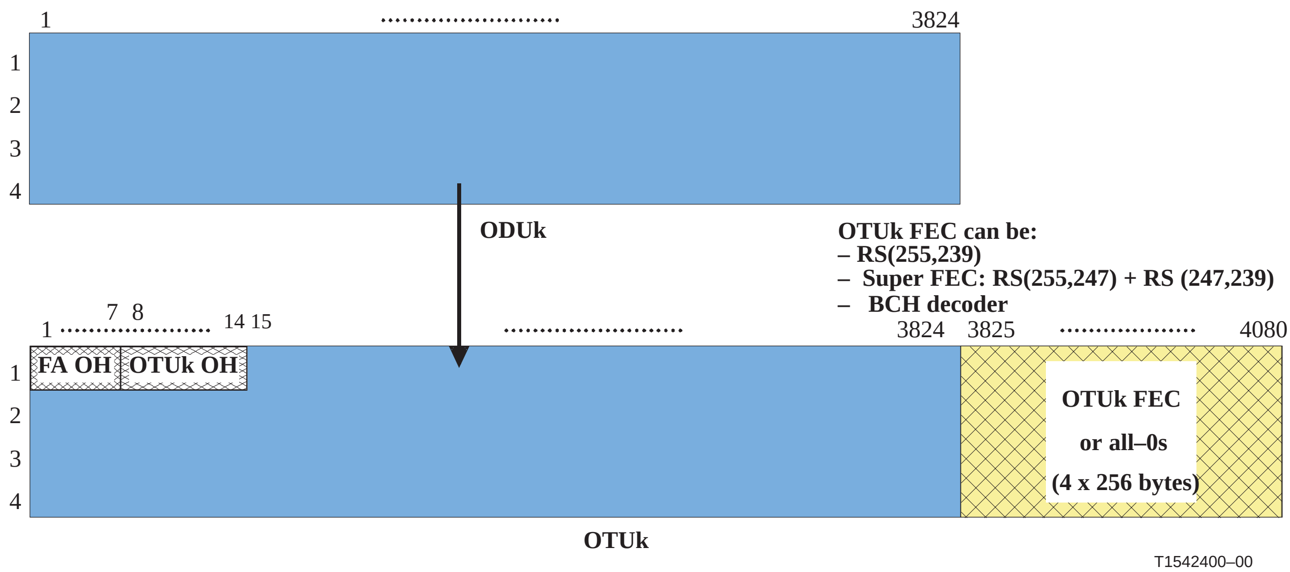


Figure 89. G.709/Y.1331 – OTUk frame structure

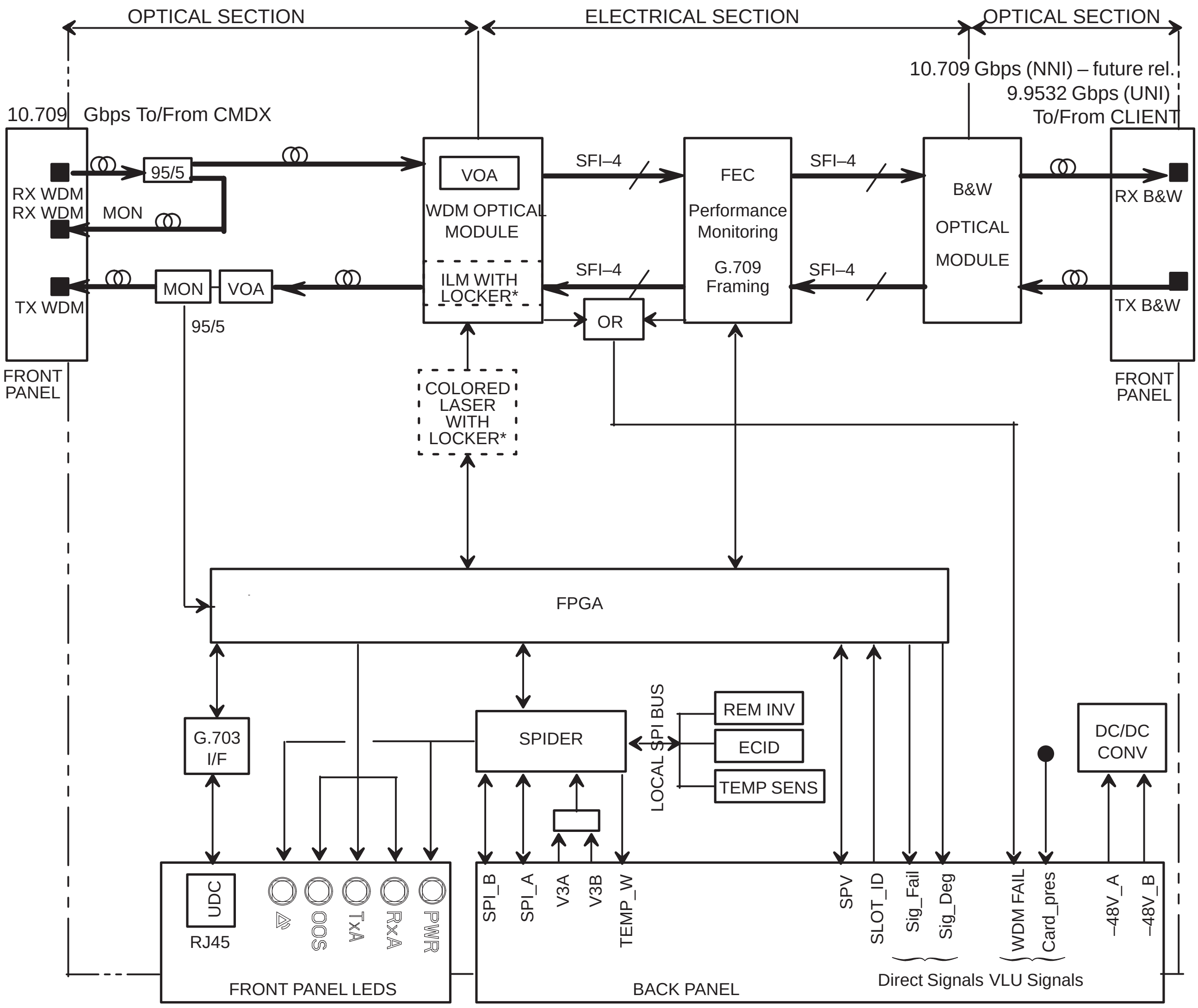
4 UNITS DESCRIPTION

This chapter describes the cards and units of the 1626 Light Manager Rel.1.2, giving for each card a functional diagram, description and interfaces definition.

4.1 Tributaries

4.1.1 TRBD1xyz (TRiButary Direct – NRZ modulation)

In the following are considered the TRBD1011, TRBD1110, TRBD1111, TRBD1121 and TRBD1131 units.



* THE COLORED LASER WITH LOCKER ALLOWS TO TUNE THE WDM INTERFACE ON THE ENTIRE C_BAND: IT IS USED BY TRBD1111, TRBD1110, TRBD1121 AND TRBD1131
* THE ILM WITH LOCKER PROVIDES ILM INTERFACE. IT IS USED BY TRBD1011. IT IS TUNABLE OVER TWO FREQUENCIES.

Figure 90. TRBD1x1z unit block diagram

4.1.1.1 Description

The block–diagram is shown on Figure 90. The TRBD1xyz unit is a bidirectional transponder, compliant with the G.709 Rec, with one B&W optical interface and one coloured (WDM) optical interface.
The TRBD1110 provides User to Network Interface (UNI)
The TRBD1011, TRBD1111, TRBD1121 and TRBD1131 provide both User to Network Interface (UNI) and Network Node Interface (NNI) on the B&W side, the NNI interface will be managed in future release.

The **Line/WDM** bidirectional optical interface is the connection to the network, and is accomplished by a coloured single wavelength on the WDM module. Each wavelength on the Line interface is then multiplexed into a single fiber and sent to the G.709 network.
The WDM interface is NNI and the bit rate is 10.709225 Gbps.
Only for the TRBD1131, the bit rate at the WDM interface is 11.09 Gbps.
The WDM optical interface generates and is able to receive NRZ signals.
On TRBD1111, TRBD1110, TRBD1121 and TRBD1131 the WDM emitter consists of a LiNbO3 Mach–Zenhder laserless modulator and a tunable laser.
On TRBD1011, the WDM emitter is an Integrated Laser Modulator (ILM), which consists in a DFB laser and an electro–absorption modulator both build on the same chip.
A low frequency modulation (60 kHz) is added on the wavelength in order to reduce stimulated Brillouin back–scattering. This feature is called SBS suppression.
The optical receiver performs an optical–to–electrical conversion and viceversa the optical transmitter.

The **Client interface** is a bidirectional optical interface providing the connection of a single wavelength of the client network with the B&W module.
The optical receiver performs an optical–to–electrical conversion and viceversa the optical transmitter.
The B&W optical interface complies with the following standards:

– ITU–T G.691 I–64.1 (2 Km reach, up to 4 dB link budget) for TRBD1111, TRBD1110 and TRBD1011
– ITU–T G.693 VSR 2000–2R1 (2 Km reach, up to 4 dB link budget) for TRBD1111, TRBD1110 and TRBD1011
– ITU–T G.691 S–64.2b (intermediate reach) for TRBD1121
– IEEE 802.3 10GBASE–LR (10 Km reach, up to 9.4 dB link budget, 1310 nm) for TRBD1131.

These applications support NRZ 10 Gbps optical tributary signals.
In UNI mode, the following B&W signals at 9.95320 Gbps are managed: STM–64, OC–192, 10 GB Ethernet WAN, other 9.95320 Gbps signals (e.g. PRBS).
Only for the TRBD1131, 10 GB Ethernet LAN B&W signals at 10.31 Gbps are supported, in UNI mode.
In NNI mode, B&W signals are OTU–2 at 10.709 Gbps (available in future release).

In UNI mode, CBR behaviour with RS monitoring is available.
In CBR mode, the unit is ready to transmit or receive any kind of client signal, whose bit rate is compliant with the B&W interface.
In the ingress direction (B&W to WDM) the unit monitors the presence of the client signal. If a failure (ILOS_BW) is detected, a generic–AIS is inserted in the payload of the ODU–2 frame.
In the egress direction (WDM to B&W) the unit inserts a generic–AIS for any failure detected at the OTU–2, ODU–2 or CBR layers.
In CBR mode, the unit level also performs a non–intrusive monitoring of the RS–layer.
Then, the SW reports all these alarms, both those from the RS and from the CBR layer (CBR mode with RS monitoring).

The 10 Gbps FEC encoder/decoder (**FEC/DEFEC**) G.709 main features are:

– new FEC Algorithm based on BCH (Ehnanced Super FEC) on WDM side”
– encoder/decoder FEC circuitry can be applied to both sides (B&W/WDM) for UNI and NNI configuration
– OTUk / ODUk Overhead processing on each side (B&W and WDM interfaces)
– Error Injection facilities (future release)
– loopback facilities (future release)
– FEC Performance Monitoring (future release)

The **FPGA** is the controller of the board. The control interface is accessed via the SPI backpanel bus. The G.709 frame Overhead Och are managed, extracted and inserted by the FPGA. Moreover, FPGA controls all commands and alarms of the board, and drives the RxA, TxA, OOS front panel leds. It is linked to the user via the SPI bus. SDH/SONET PM (RS monitoring) is implemented on both sides.
FPGA main features:

– Controls and alarms of the WDM and B&W optical modules
– Tune, Controls and alarms of the Laser Tunable optical module
– Management of the G.709 FEC encoder/decoder
– VOA and DTV control
– G.703 channel management (T1/E1), on the User Data Channel signal (future release)
– PLL selection and VOA calibration
– SPI buses Interface
– Miscellaneous, including alarms, temperature board and leds.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID, FPGA) are connected permitting the Shelf Controller to acknowledge data (RI, Card type, Alarms..) from the board. Moreover, it drives the PWR, and front panel leds.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

TRBDs buses and dedicated links

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Measurement, Controls and tunings. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres and WDM_fail are Output signals carrying the Card Presence and WDM line failure information. They are 2–wire dedicated (backpanel) links connecting each one of slots 3 to 18 with slot 22

The Sig_fail, Sig_deg respectively the Signal Fail and Signal Degrade information. They are 2–wire dedicated (backpanel) links connecting each one of slots 3 to 18 with slot 39

The UDC_1 and UDC_2 are I/O signals carrying the 2Mbps (E1) or 1.5Mbps (T1) G.703 User Data Channel. They are available on the front plate (future release).

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above the limit. It is launched when the N_WARNING alarm is raised on the board.

The SPV is an I/O signal carrying the 2 Mbps supervision channel (OSC). This backpanel signal allows to exchange the relevant data with ESCT1000.

The Protection_bus is an I/O signal carrying TTI values and APS/PCC information. It is a 4–wire dedicated (backpanel) link; it is connected to slots 3 to 18 and slot 39 (used in future release).

4.1.1.2 Brief description of the main features of each TRBD

The **TRBD1011** is a bidirectional G.709 transponder with high sensitivity receiver, ILM coloured interface – NRZ modulation, VSR B&W interface, Smeraldo 3 ASIC (high FEC). It is tunable over two frequencies. It provides both User to Network Interface and Network Node Interface (NNI will be fully operative in future releases).

The **TRBD1111** is is a bidirectional G.709 transponder with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, VSR B&W interface, Smeraldo 3 ASIC (high FEC).
According to the board type (two different codes) it can be tuned over a sub–band of 8 channels or over the whole Extended C–band.
It provides both User to Network Interface and Network Node Interface (NNI will be fully operative in future rel.).

The **TRBD1110** is is a bidirectional G.709 transponder with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, VSR B&W interface, Tiziano 3 ASIC (medium FEC).
It is tunable over the whole Extended C–band and provides User to Network Interface.

The **TRBD1121** is is a bidirectional G.709 transponder with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, intermediate reach S–64.2b B&W interface, Smeraldo 3 ASIC (high FEC). According to the board type (two different codes) it can be tuned over a sub–band of 8 channels or over the whole Extended C–band.
It provides both User to Network Interface and Network Node Interface (NNI will be fully operative in future releases).

The **TRBD1131** is a bidirectional G.709 transponder with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, 10GBASE–LR (10 GBE LAN) B&W interface, Smeraldo 3 ASIC (high FEC). It is tunable over the whole Extended C–band.
It provides User to Network Interface.

4.1.1.3 Frequency allocation

For all the transponders, the information on the allowed frequencies is contained in the ECID.
The software can read from the ECID: the minimum allowed frequency, the maximum allowed frequency and the frequency step, also called grid.
The TRBD1011 is tunable over a set of 2 frequencies, 50 GHz spaced. As a consequence, 48 versions of this unit are needed in current release.
The TRBD1111, TRBD1110, TRBD1121 and TRBD1131 are tunable over the entire Extended C–band.
The TRBD1111 and TRBD1121 are also tunable over a sub–band of 8 channels. 13 versions of this unit are available in current release.
The frequency plan is shown in Table 12. on page 129.

4.1.1.4 TRBD1xyz optical characteristics

See para. 5.3.1.1 on page 219.

4.1.1.5 Loopbacks

The loop–backs defined here below shall be available to the user interface on the TRBD1011, TRBD1111, TRBD1121 and TRBD1131 units. Their purpose is to give the possibility to the operator to perform some tests or maintenance operations on an installed equipment.
The loopbacks are performed by the FEC encoder/decoder.
The following loop–back functions shall be available:

– **B&W line loop & continue**: the client signal received on the B&W interface is copied and sent back through the B&W emitter. This signal is also transmitted as usual to the WDM interface.
– **WDM line loop & continue**: the signal received on the WDM interface is copied and sent back through the WDM emitter. It is also transmitted to the B&W interface.

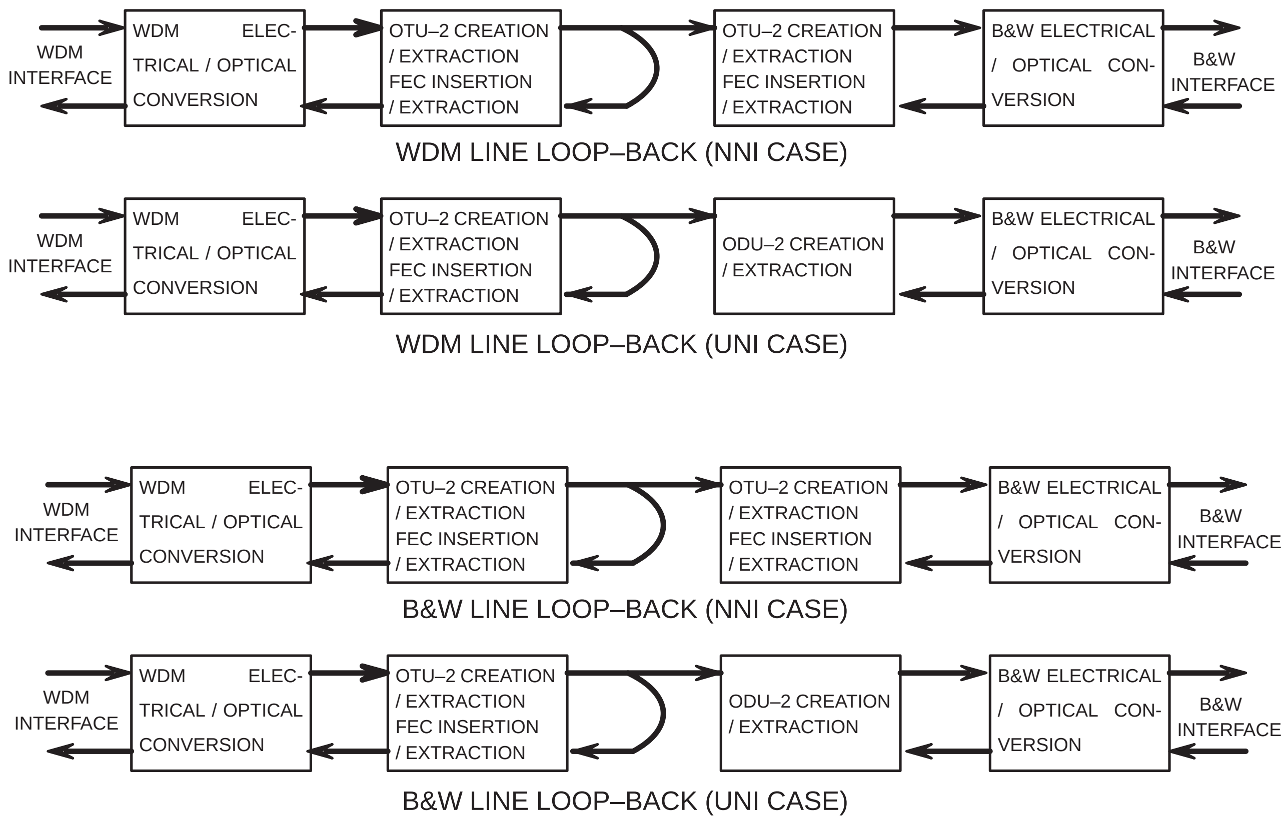


Figure 91. Loop–backs on TRBD1011, TRBD1111, TRBD1121 and TRBD1131

4.1.1.6 Unit start–up

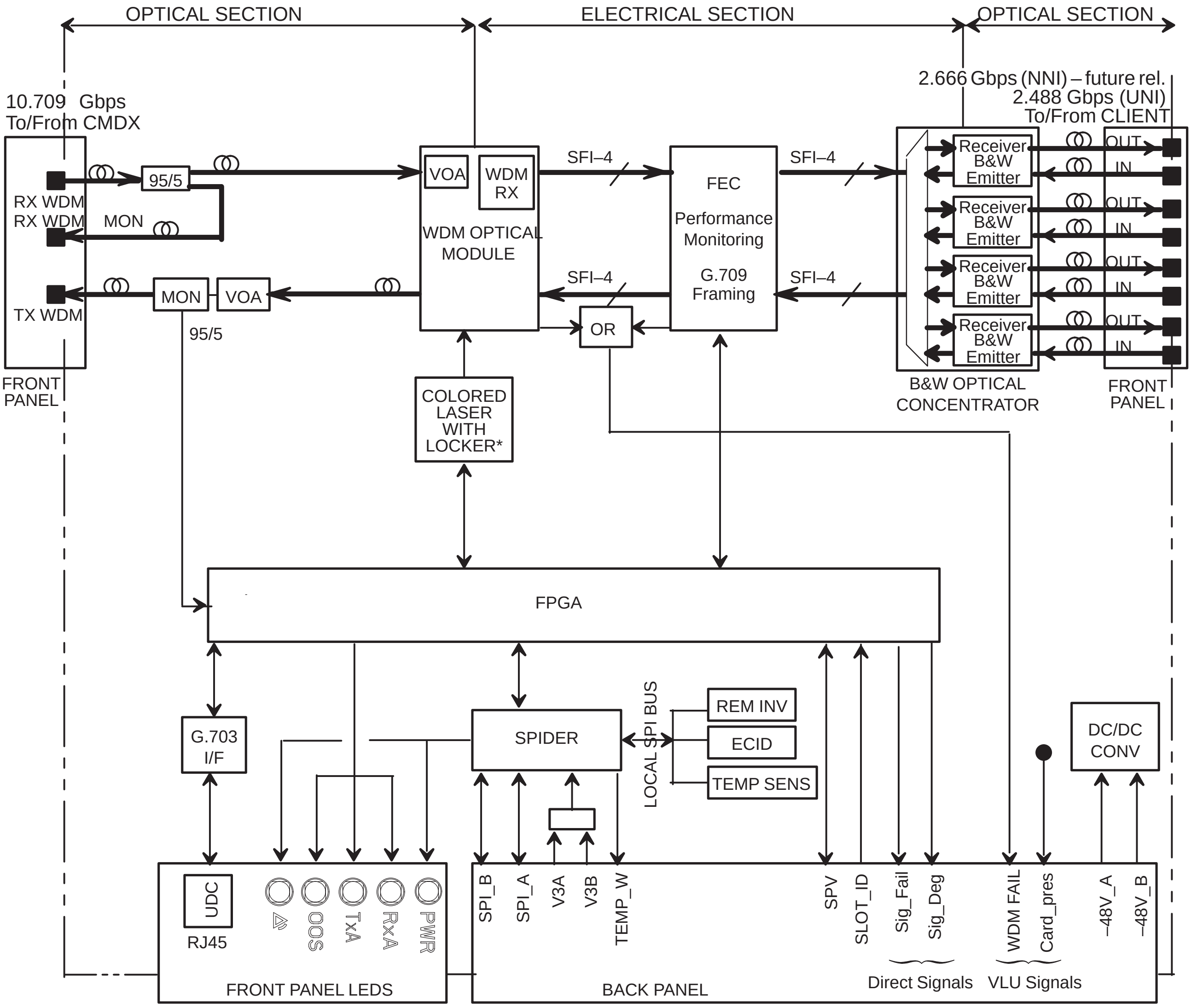
4.1.1.6.1 Initialisation

Once plugged, before unit provisioning and cabling declaration, the laser is in the Off–state and the VOA at maximum of attenuation.
The laser is switched On after the unit provisioning and optional cabling declaration to the CMDX. During the switch–on time, the VOA is at maximum of attenuation.

4.1.1.6.2 Unit re–start after replacement

All the provisionings of the unit that is being replaced are stored in SW so that they are downloaded to the new unit as soon as it is plugged. During the laser switch–on time, the VOA is at maximum of attenuation.

4.1.2 TRBC1111 (TRiButary Concentrator – NRZ modulation, VSR, High FEC gain)



* THE COLORED LASER WITH LOCKER ALLOWS TO TUNE THE WDM INTERFACE ON THE ENTIRE C_BAND

Figure 92. TRBC1111 unit block diagram

4.1.2.1 Description

The block–diagram is shown on Figure 92. The TRBC1111 unit is a bidirectional transponder, compliant with the G.709 Rec, that concentrates four incoming B&W optical streams in one coloured (WDM) optical signal. The TRBC1111 provides both User to Network Interface (UNI) and Network Node Interface (NNI) on the B&W side, the NNI interface will be managed in future release.

The **Line/WDM** bidirectional optical interface is the connection to the network, and is accomplished by a coloured single wavelength on the WDM module. Each wavelength on the Line interface is then multiplexed into a single fiber and sent to the G.709 network.
The WDM interface is NNI and the bit rate is 10.709225 Gbps.
The WDM optical interface generates and is able to receive NRZ signals.
The WDM emitter consists of a LiNbO3 Mach–Zenhder laserless modulator and a tunable laser.
A low frequency modulation (60 kHz) is added on the wavelength in order to reduce stimulated Brillouin back–scattering. This feature is called SBS suppression.
The optical receiver performs an optical–to–electrical conversion and viceversa the optical transmitter.

Client interface. The TRBC1111 unit has four B&Woptical input/outupt on the front panel of the unit.
The B&W interfaces are Small Form Pluggable modules compliant with the I–16.1 or S–16.1 standard.
The B&W optical interfaces are LC/SPC connectors. The B&W modules can be extracted/inserted via the front panel without removing the board.
It is possible to individually provision (declare to the manager system) the four B&W modules.
The optical receiver performs an optical–to–electrical conversion and viceversa the optical transmitter.
In UNI mode, the following B&W signals at 2.488 Gbps are managed:

- ITU–T G.957 STM–16
- OC–48.

In NNI mode, B&W signals are OTU–2 at 2.666 Gbps (available in future release).
In UNI mode, CBR behaviour with RS monitoring is available.
In CBR mode, the unit is ready to transmit or receive any kind of client signal provided their bit rate is compliant with the B&W interface.
In the ingress direction (B&W to WDM) the unit monitors the presence of the client signal. If a failure (ILOS_BW) is detected, a generic–AIS is inserted in the payload of the ODU–1 frame.
In the egress direction (WDM to B&W) the unit inserts a generic–AIS for any failure detected at the OTU–2, ODU–2, ODU–1 or CBR layers.
In CBR mode, the unit level also performs a non–intrusive monitoring of the RS–layer. Then, the SW reports all these alarms, both those from the RS and from the CBR layer (CBR mode with RS monitoring)
N.B. In the egress direction, whatever the mode, if the unit detects a Client–AIS, it replaces it by a RS–AIS. Thus, the Client–AIS is a kind of RS–AIS specific to the 1626 LM and it is never sent outside the 1626 LM line.

The 10 Gbps FEC encoder/decoder (**FEC/DEFEC**) G.709 main features are:

- new FEC Algorithm based on BCH (Ehnanced Super FEC) on WDM side
- encoder/decoder FEC circuitry can be applied to both sides (B&W/WDM) for UNI and NNI configuration
- OTUk / ODUk Overhead processing on each side (B&W and WDM interfaces)
- Error Injection facilities (future release)
- loopback facilities (future release)
- FEC Performance Monitoring (future release)

The **FPGA** is the controller of the board. The control interface is accessed via the SPI (ISPB in future rel.) backpanel bus. The G.709 frame Overhead Och are managed, extracted and inserted by the FPGA. Moreover, FPGA controls all commands and alarms of the board, and drives the RxA, TxA, OOS leds. It is linked to the user via the SPI bus. SDH/SONET PM (RS monitoring) is implemented on both sides.
FPGA main features:

- Controls and alarms of the WDM and B&W optical modules
- Tune, Controls and alarms of the Laser Tunable optical module
- Management of the G.709 FEC encoder/decoder
- VOA and DTV control
- G.703 channel management (T1/E1), on the User Data Channel signal (future release)
- PLL selection and VOA calibration
- SPI buses Interface
- Miscellaneous, including alarms, temperature board and leds.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID, FPGA) are connected permitting the Shelf Controller to acknowledge data (RI, Card type, Alarms..) from the board. Moreover, it drives the PWR, and  front panel leds.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

TRBC1111 buses and dedicated links

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Measurement, Controls and tunings. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres and WDM_fail are Output signals carrying the Card Presence and WDM line failure information. They are 2–wire dedicated (backpanel) links connecting each one of slots 3 to 18 with slot 22

The Sig_fail**,** Sig_deg respectively the Signal Fail and Signal Degrade information. They are 2–wire dedicated (backpanel) links connecting each one of slots 3 to 18 with slot 39

The UDC_1 and UDC_2 are I/O signals carrying the 2Mbps (E1) or 1.5Mbps (T1) G.703 User Data Channel. They are available on the front plate (future release).

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above the limit. It is launched when the N_WARNING alarm is raised on the board.

The SPV is an I/O signal carrying the 2 Mbps supervision channel. This backpanel signal allows to exchange the relevant data with ESCT1000 (future use).

The Protection_bus is an I/O signal carrying TTI values and APS/PCC information. It is a 4–wire dedicated (backpanel) link; it is connected to slots 3 to 18 and slot 39 (used in future release)

4.1.2.2 Brief description of the main features of TRBC

The **TRBC1111** is a bidirectional G.709 transponders with four B&W and one coloured optical interfaces. It is provided with high sensitivity receiver, LiNbO3 Mach–Zehnder coloured interface – NRZ modulation, VSR B&W interface, Smeraldo 3 ASIC (high FEC). It is tunable over the whole Extended C–band.
It provides both User to Network Interface and Network Node Interface (NNI will be fully operative in future releases).

4.1.2.3 Frequency allocation

For all transponders, the information on the allowed frequencies is contained in the ECID.
The software can read from the ECID: the minimum allowed frequency, the maximum allowed frequency and the frequency step, also called grid.
The **TRBC1111** is tunable over the entire Extended C–band.
The frequency plan is shown in Table 12. on page 129.

4.1.2.4 TRBC1111 optical characteristics

See para. 5.3.1.2 on page 221.

N.B. The signal may not be seen if the LSP (Laser Shutdown for Protection) is active.

4.1.2.5 ODU1 multiplexing

The multiplexing structure of the TRBC1111 is compliant with the ITU–T G709/Y.1331 recommendation.
Figure 93. illustrates the multiplexing of the four ODU1 signals into an ODU2.
The four ODU1s are extended with frame alignment overhead and a justification overhead; then they are time division multiplexed (bit interleaving) into the ODU2. ODU2 overhead is added after having mapped the ODU2 into the OTU2.
The four incoming signals can be fully asynchronous. The stuffing overheads are inserted by the ASIC (FEC, PM, G.709 framing) in order that the client signal (e.g. STM16) is fully transparently transmitted.

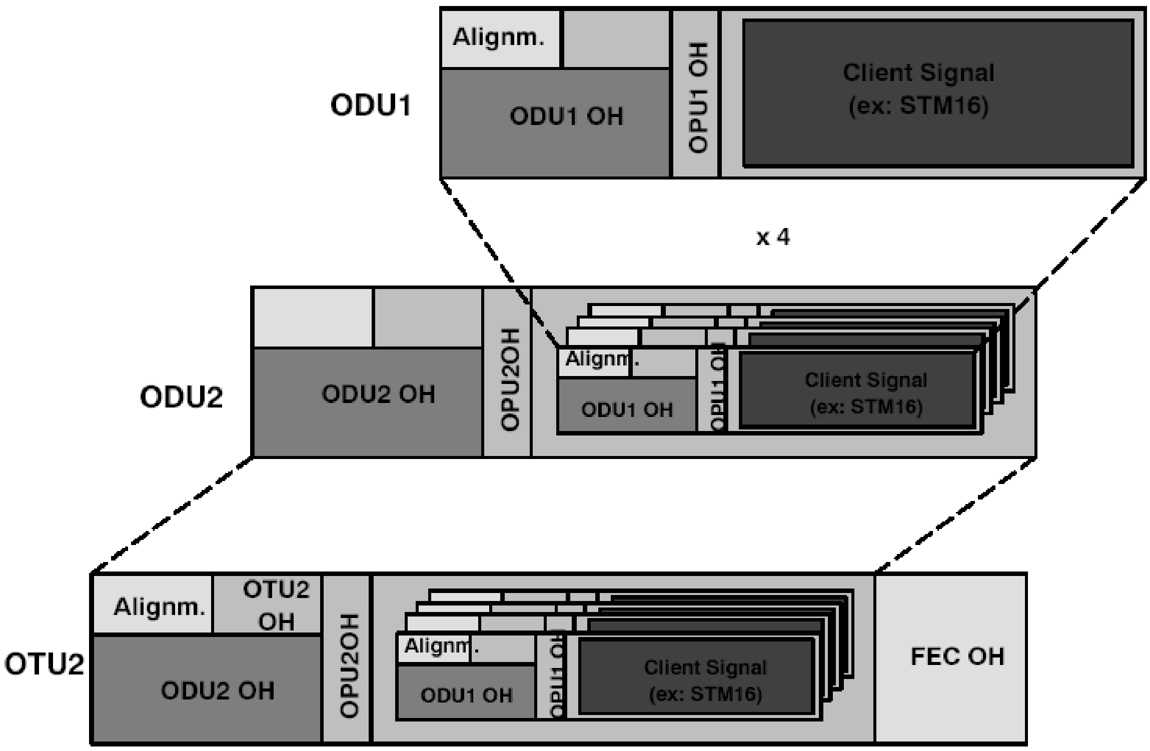


Figure 93. Multiplexing of 4 ODU1 into an ODU2

4.1.2.6 Loopbacks

The loop–backs defined here below shall be available to the user interface on the TRBC1111 unit.
Their purpose is to give the possibility to the operator to perform some tests or maintenance operations on an installed equipment.
The loopbacks are performed by the FEC encoder/decoder.
The following loop–back functions shall be available:

– **B&W line loop & continue**: the client signal received on the B&W interface is copied and sent back through the B&W emitter. This signal is also transmitted as usual to the WDM interface.
– **WDM line loop & continue**: the signal received on the WDM interface is copied and sent back through the WDM emitter. It is also transmitted to the B&W interface.

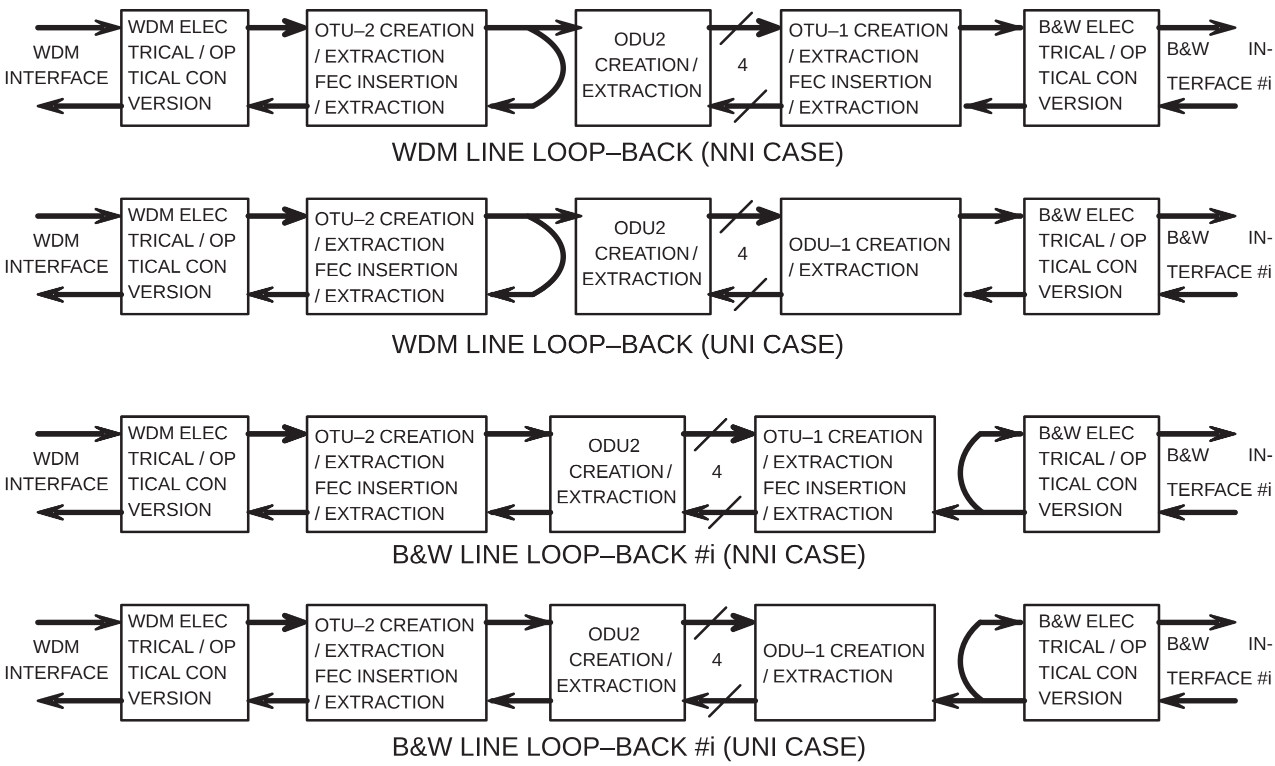


Figure 94. Loop–backs on TRBC1111

4.1.2.7 Unit start–up

4.1.2.7.1 Initialisation

Once plugged, before unit provisioning and cabling declaration, the laser is in the Off–state and the VOA at maximum of attenuation.
The laser is switched On after the unit provisioning and optional cabling declaration to the CMDX. During the switch–on time, the VOA is at maximum of attenuation.

4.1.2.7.2 Unit re–start after replacement

All the provisionings of the unit that is being replaced are stored in SW so that they are downloaded to the new unit as soon as it is plugged. During the laser switch–on time, the VOA is at maximum of attenuation.

4.1.3 STM–16 optical modules

See Figure 95. on page 170.

The SFP (Small Formfactor Pluggable) STM–16 optical modules are the optical physical accesses for the TRBC1111 board, client side.
Up to four modules can be housed in each board.

The SFP optical module is S–16.1.
Optical fibres are connected to the optical module through Small Formfactor Pluggable with LC/PC connector.

Each module contains on transmitter side an automatic optical output power control circuit, a laser driver and a laser diode module.
The transmitter is based on an uncooled DFB laser.
The laser safety class for the complete integrated module is CLASS 1 according to IEC 60825 2001 Edition.
It can manage command for TX disable and provides TX Fault alarm.
Depending on the SFP type, the optical access is compatible with
– a single mode fiber (9/125 µm) or
– multi mode fiber (50/125 µm or 9/125 µm)
with standard LC optical connector.
TX Fault indicates a laser fault of some kind. The Transmitter is not disabled when TX Fault signal is active.
Tx Disable is an input that is used to shut down the transmitter optical output.

On receiver side each module contains a PIN photodetector for light to electrical current conversion and a limiting amplifier.
The photo detected current is amplified by a an electrical circuit which delivers two complementary data signals.
The module provides LOS alarm (Loss of input Power Signal alarm). This output signal indicates the received optical power is below the worst–case receiver sensitivity (as defined by the standard in use).
Depending on the SFP type, the optical access is compatible with
– a single mode fiber (9/125 µm) or
– multi mode fiber (50/125 µm or 9/125 µm)
with standard LC optical connector.

The Transceiver has an EEPROM inside to provide Remote Inventory, containing information about transceiver's capabilities, standard interfaces, manufacturer, and others. The serial interface uses the 2–wire serial CMOS EEPROM protocol defined for the ATMEL AT24C01A/02/04 family of components.
Digital diagnostic monitoring (DDM) of analog parameters is supported.

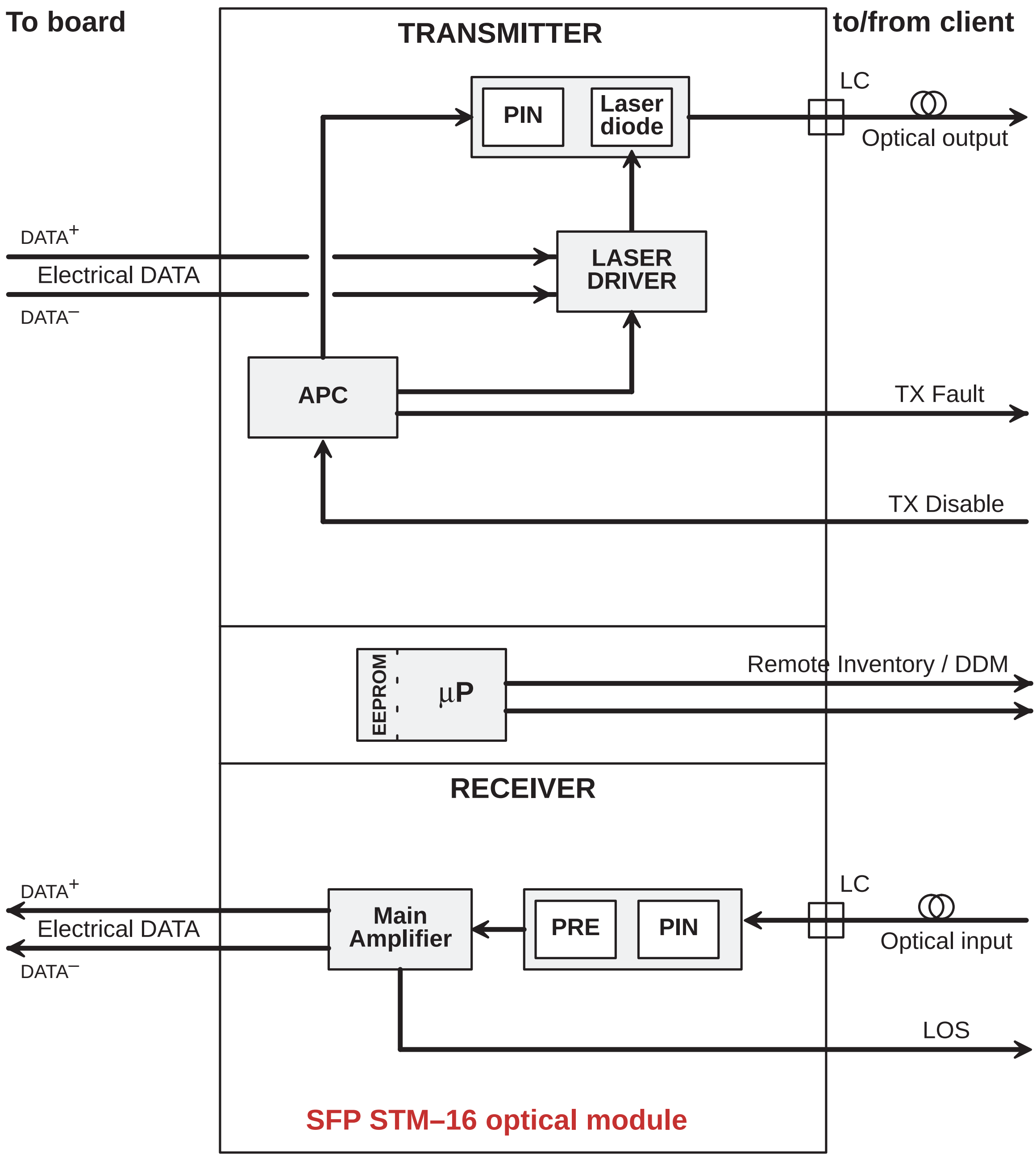


Figure 95. STM–16 SFP optical module block diagram

4.2 Multiplexers/demultiplexers

4.2.1 CMDX1010 (8:1 and 1:8 Channel Multiplexer / DemultipleXer, 50 GHz grid – CMX/CDX)

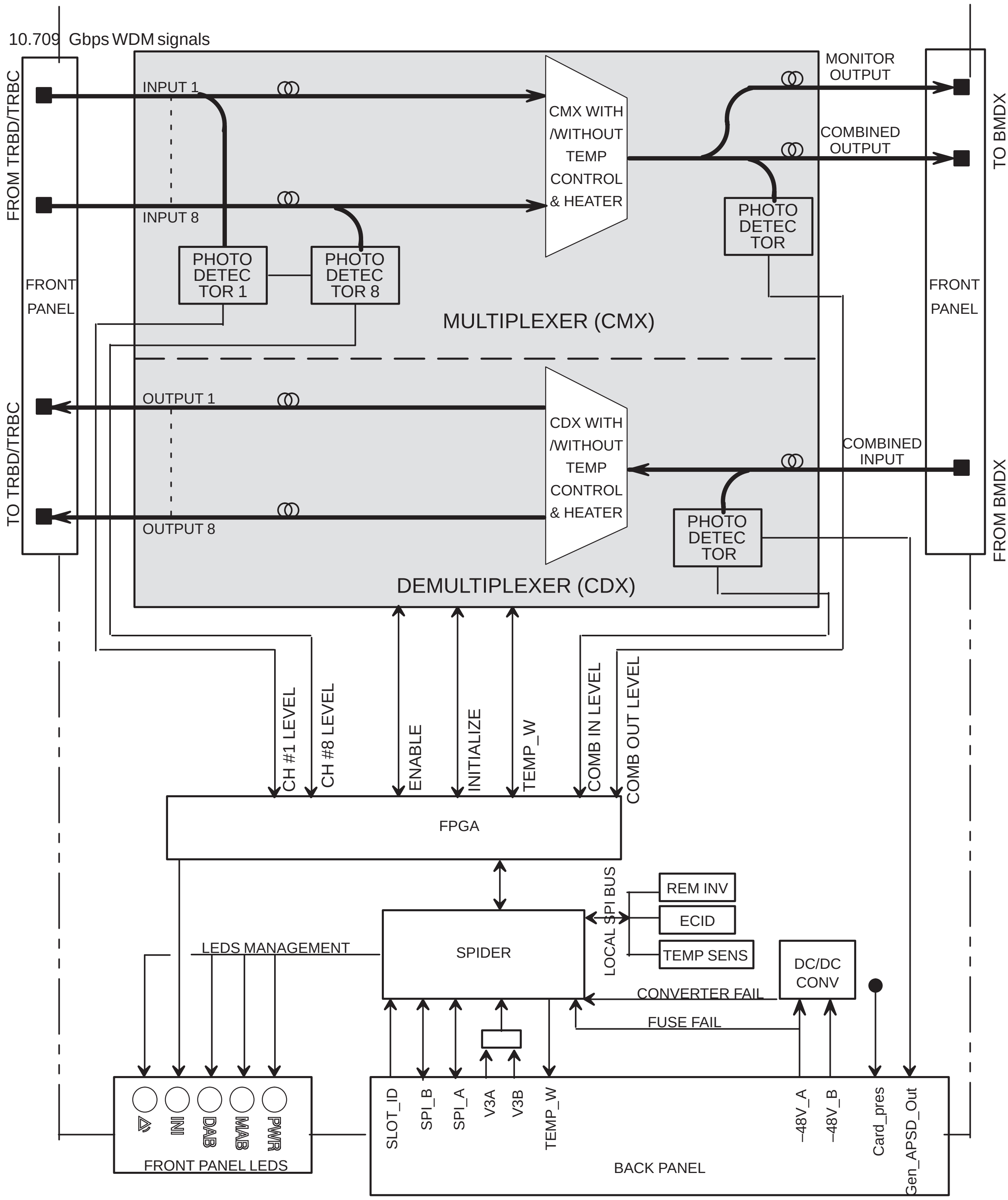


Figure 96. CMDX1010 block diagram

4.2.1.1 Description

The block–diagram is shown in Figure 96. The CMDX1010 is a bi–directional unit used for multiplexing and demultiplexing in each of the 12 sub–bands of the Extended C–band. Hence, in current release, twelve (on grid) variants of this board, each covering a 8–channel band, are needed to cover the 96 channels of the Extended C–band.
The CMDX1010 is used in terrestrial and submarine links.

The Channel Multiplexer / DemultipleXer unit contains a 8:1 multiplexer (CMX), @ 50 GHz grid, and a 1:8 demultiplexer (CDX), @ 50 GHz grid.

In transmit direction, the CMDX1010 is used to multiplex (CMX) eight optical channels, coming from eight transmitters (transponders), into a single output port. The multiplexed signal is further routed to the BMDX.

In receive direction, the CMDX1010 is used to demultiplex (CDX) a combined WDM optical signal, coming from the appropriate demultiplexer output of the BMDX, into eight WDM output signals, each one further routed to the relevant optical receiver (transponder).

In transmit direction, each covering a 8–channel band8 input ports, 1 output port and 1 optical output monitor port for the multiplexer (CMX).
In receive direction, 1 input port and 8 output ports for the demultiplexer (CDX) are provided.

Each of the 8 input ports and the output port of the multiplexer (CMX) have a tap coupler and a photo detector to electrically monitor the optical power level. An additional tap coupler is provided at the output signal, allowing optical monitoring by means of a MU/SPC connector available on the front panel.
The input port of the demultiplexer (CDX) has a tap coupler and a photo detector to electrically monitor the optical power level.
The power level alarming functionality (managed by FPGA) is provided.

The CMDX1010 has the capability of shutting down an upstream amplifier if a LOS (Loss Of Signal) is detected at the demultiplexer input. This is achieved via a high reliability connection from the demultiplexer input optical level monitor to the back panel and through a dedicated link to the amplifier (future rel.).

Temperature control circuitry is provided within the mux / demux filter. The unit is required to reach operating temperature within 10 minutes after having plugged it in; within this period, the INI led is ON to indicate that the board is not yet at operating temperature.

The **FPGA** allows managing of all the alarms (including optical levels) before being processed by the Shelf Controller. The INI (INItialization) led is managed by FPGA.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID, FPGA) are connected permitting the Shelf Controller to acknowledge data (RI, Card type, Alarms..) from the board. It drives the PWR, MAB, DAB and  leds.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

CMDX1010 buses and dedicated links

The V3A and V3B are duplicated Input power supplies (+3.7Vdc). They are combined on the unit using sharing diodes to provide a 3.3V DC power supply to SPIDER device.

The 48V_A and 48V_B are duplicated Input power supplies (–48Vdc or –60Vdc) compliant with ETS 300 132–2

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Measurement, Controls. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres Output signal carryies the Card Presence information. It is a dedicated (backpanel) wire between CMDX and Shelf Controller.

The GEN_APSD_OUT is an Output signal raised on RLL failure at the Demux input. It is used for safety reasons to provide automatic power shutdown (APSD) of an upstream amplifier. Backpanel links with the GENAPSD bus.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above a pre–defined thrshold.

4.2.1.2 Brief description of the main features of CMDX

The **CMDX1010** is the 8:1 and 1:8 Channel Multiplexer & DemultipleXer, on a 50 GHz grid and AWG technology. The AWG devices provide the mux and demux function and the active temperature control to maintain wavelength stability.
It work in one 8–channel sub–band of the C–band; thus 12 different CMDX boards are needed to cover the entire extended C–band.

4.2.1.3 Frequency allocation

For all the CMDX variants, the information on the allowed frequencies is contained in the ECID.
The software can read from the ECID information about allowed frequencies and the frequency step, also called grid.
The frequency plan is shown in Table 12. on page 129. where the 8–frequency/channel of Band 1 correspond to the frequencies/channels multiplexed/demultiplexed by the CMDX1010 B1 (3AL95507AA—), the 8–frequency of Band 2 correspond to the frequencies/channels multiplexed/demultiplexed by the CMDX1010 B2 (3AL95507AB—) and so on.
The CMX and CDX ports are labelled with the channel centre frequency in THz, e.g. the 195.900 label corresponds to the channel centre frequency of 195.900 THz. One label is used for both CMX and CDX, and the CMX ports appear above the CDX ports, on the front panel.
The order of the ports on the front panel is as follows: uppermost port is the Output Monitor; below is the highest frequency CMX and CDX ports, these descend in frequency (interleaving CMX and CDX ports) with the lowest frequency towards the bottom of the card, and below these are the CMX and CDX common ports, respectively.

4.2.1.4 CMDX1010 optical characteristics

See para. 5.3.2.1 on page 223.

4.2.1.5 Unit Start–up

4.2.1.5.1 Initialisation

When inserting the CMDX1010 into the subrack, the shelf controller configures the provisionable parameters. Then, both the CMX and CDX heaters and temperature controls are autonomously enabled by the hardware.
The unit remains in the initialisation state (INI) for the first 10 minutes or until both CMX and CDX have reached set temperature, whichever is earlier. In the initialisation state the INI led is illuminated under the control of the hardware/firmware.
Optical level monitors, enabled during initialisation, are present at the input and output of the CMX and at the input only of the CDX.

4.2.1.5.2 Unit Re–start after Replacement

Re–start as for initialisation.

4.2.2 BMDX1000 (12:1 and 1:12 Band Multiplexer/DemultipleXer – BMX/BDX)

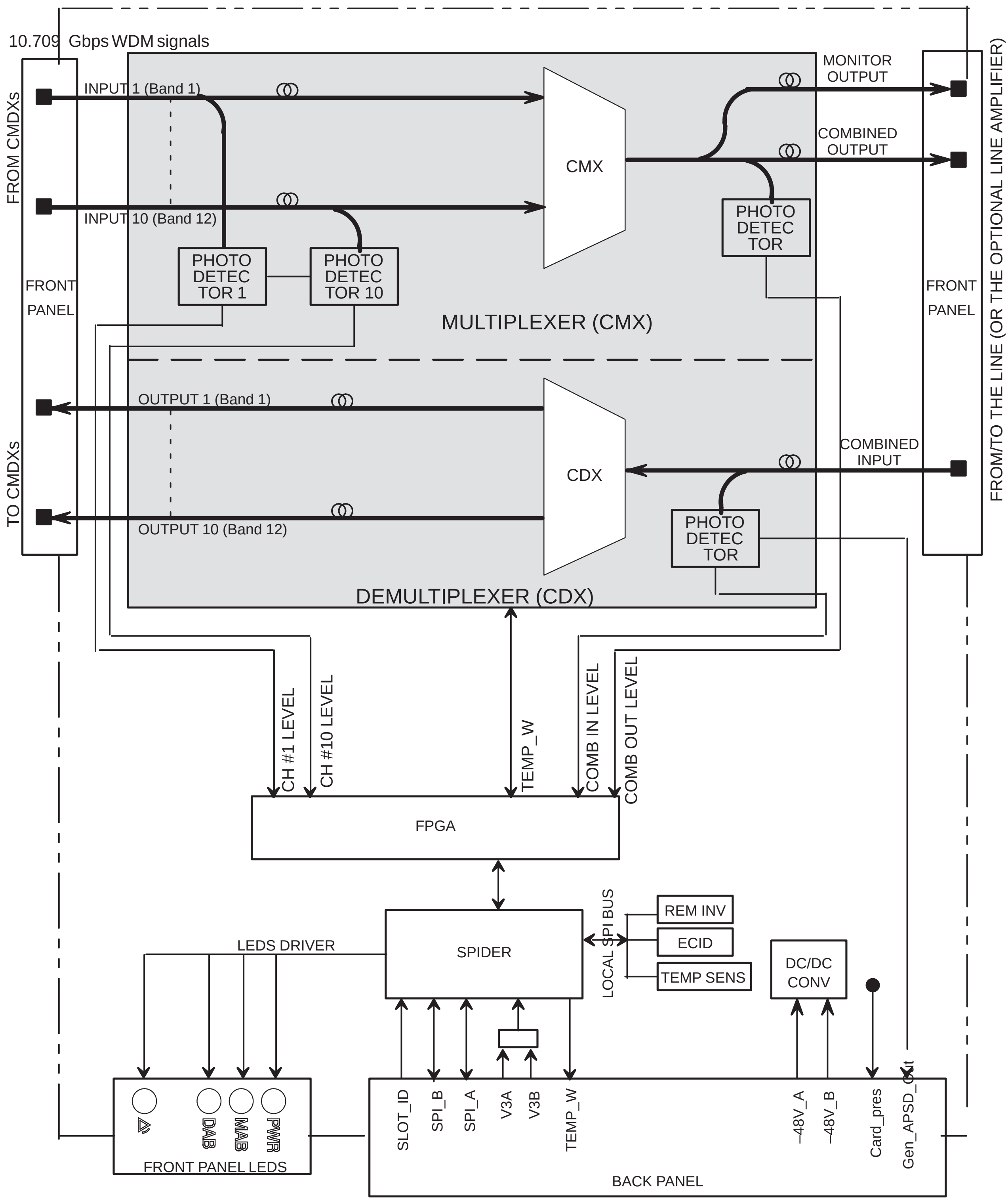


Figure 97. BMDX1000 block diagram

The block–diagram is shown on Figure 97. The BMDX1000 is a bi–directional unit used for multiplexing the 12 sub–bands (8–channel, GHz spaced each) of the C–band into the combined/aggregate signal (and viceversa in demultiplexing direction).

The Band Multiplexer / DemultipleXer unit contains a 12:1 multiplexer (CMX) and a 1:12 demultiplexer (CDX).

The 12:1 multiplexer (BMX) is able to multiplex twelve optical input signals, coming from CMDXs, into a single composite output signal (made up of 96 channels max.).
Each of the BMX input signals contains a 8–channel band.
The multiplexed/aggregate signal is further routed to the optional line amplifier and then sent to the line.

The 1:12 demultiplexer (BDX) is able to demultiplex a composite WDM optical signal, coming from the line, into twelve WDM output signals, each one further routed to the appropriate CMDX.

The BMX provides 12 input ports and 1 output port, each of the inputs being allocated to a specific band multiplexed by a CMDX.
The BDX provides 1 input port, containing 12 bands, and 12 output ports.
A description of the channels multiplexed/demultiplexed at each input/output port is given in Table 16.

Each of the 12 input ports and the output port of the multiplexer (BMX) have a tap coupler and a photo detector to electrically monitor the optical power level. An additional tap coupler is provided at the output signal, allowing optical monitoring by means of a MU/SPC connector available on the front panel.
The input port of the demultiplexer (BDX) has a tap coupler and a photo detector to electrically monitor the optical power level.
The power level alarming functionality (managed by FPGA) is provided.

The BMDX1000 is also able to send a shut down command through the back panel to an amplifier (future release), in case of LOS detection at the BDX input (see Safety Chapter).

The **FPGA** allows managing of all the alarms (including optical levels) before being processed by the Shelf Controller.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID, FPGA) are connected permitting the Shelf Controller to acknowledge data (RI, Card type, Alarms..) from the board. It drives the PWR, MAB, DAB and leds.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

BMDX1000 buses and dedicated links

The V3A and V3B are duplicated Input power supplies (+3.7Vdc). They are combined on the unit using sharing diodes to provide a 3.3V DC power supply to SPIDER device.

The 48V_A and 48V_B are duplicated Input power supplies (–48Vdc or –60Vdc) compliant with ETS 300 132–2

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Measurement, Controls. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres Output signal carryies the Card Presence information. It is a dedicated (backpanel) wire between BMDX and Shelf Controller.

The GEN_APSD_OUT is an Output signal raised on RLL failure at the Demux input. It is used for safety reasons to provide automatic power shutdown (APSD) of an upstream amplifier. Backpanel links with the GENAPSD bus.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above a pre–defined threshold.

4.2.2.1 Frequency allocation

The following table details the channels multiplexed/demultiplexed at each input/output port of the BMDX1000 (see also Table 12. on page 129 for the frequency plan).

Table 16. Multiplxed/demultiplexed channels by BMDX1000 on 50GHz grid and band centre frequency

	Centre frequency / Centre λ	Port number
Band 1	195.7125 THz/1531.800 nm	195.712
Band 2	195.3125 THz/1534.937 nm	195.312
Band 3	194.9125 THz/1538.087 nm	194.912
Band 4	194.5125 THz/1541.250 nm	194.512
Band 5	194.1125 THz/1544.426 nm	194.112
Band 6	193.7125 THz/1547.615 nm	193.712
Band 7	193.3125 THz/1550.818 nm	193.312
Band 8	192.9125 THz/1554.033 nm	192.912
Band 9	192.5125 THz/1557.262 nm	192.512
Band 10	192.1125 THz/1560.505 nm	192.112
Band 11	191.7125 THz/1563.761 nm	191.712
Band 10	192.3125 THz/1567.030 nm	192.312

4.2.2.2 Brief description of the main features of BMDX1000

The **BMDX1000** is the 12:1 and 1:12 Band Multiplexer & DemultipleXer for Line Terminal and Back–to–back applications.

4.2.2.3 BMDX1000 optical characteristics

See para. 5.3.2.2 on page 224.

4.2.2.4 Unit Start–up

4.2.2.4.1 Initialisation

On insertion of the BMDX1000 into the subrack, the shelf controller configures the provisionable parameters.

4.2.2.4.2 Unit Re–start after Replacement

Re–start as for initialisation

4.2.3 BMDX1100 (12:1 and 1:12 Band Multiplexer/DemultipleXer for Band OADM)

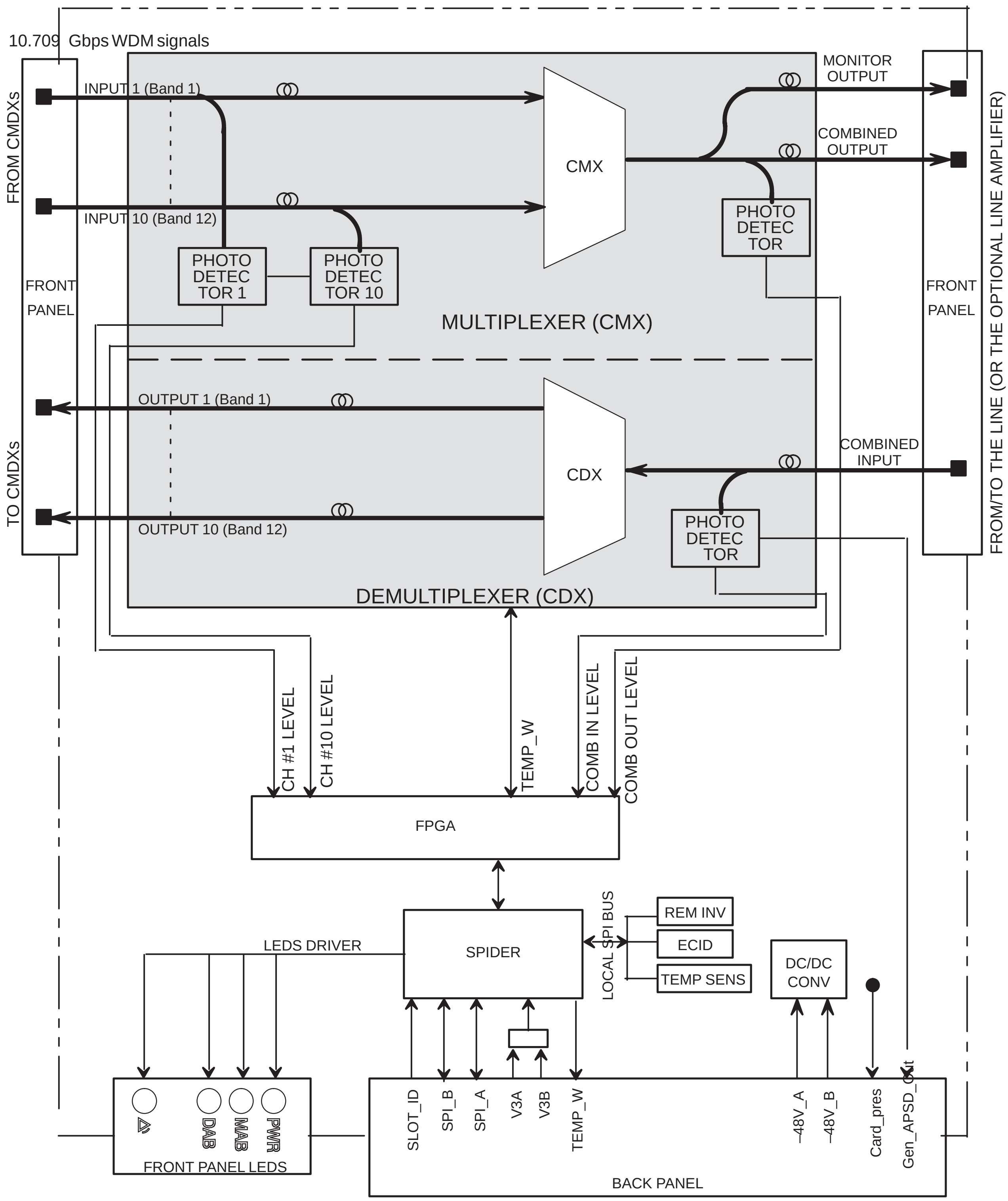


Figure 98. BMDX1100 block diagram

The block–diagram is shown on Figure 98. The BMDX1000 is a bi–directional unit used for multiplexing the 12 sub–bands of the Extended C–band into the combined/aggregate signal (and viceversa in demultiplexing direction).

The Band Multiplexer / DemultipleXer unit contains a 12:1 multiplexer (CMX) and a 1:12 demultiplexer (CDX).

The 1:12 demultiplexer (BDX) is able to demultiplex a composite WDM optical signal, coming from the line, into twelve WDM output signals,
When using the BMDX1100 the number of channels in each band is reduced to 7.
Each band is further routed to the appropriate CMDX.

The 12:1 multiplexer (BMX) is able to multiplex twelve optical input signals, coming from CMDXs, into a single composite output signal (made up of 96 channels max.).
Each of the BMX input signals contains a band (7–channel max.).
The multiplexed/aggregate signal is further routed to the optional line amplifier and then sent to the line.

The BMX provides 12 input ports and 1 output port, each of the inputs being allocated to a specific band multiplexed by a CMDX.
The BDX provides 1 input port, containing 12 multiplexed bands, and 12 output ports.
A description of the channels multiplexed/demultiplexed at each input/output port is given in Table 17.

Each of the 12 input ports and the output port of the multiplexer (BMX) have a tap coupler and a photo detector to electrically monitor the optical power level. An additional tap coupler is provided at the output signal, allowing optical monitoring by means of a MU/SPC connector available on the front panel.
The input port of the demultiplexer (BDX) has a tap coupler and a photo detector to electrically monitor the optical power level.
The power level alarming functionality (managed by FPGA) is provided.

The BMDX1100 is also able to send a shut down command through the back panel to an amplifier (future release), in case of LOS detection at the BDX input (see Safety Chapter).

The **FPGA** allows managing of all the alarms (including optical levels) before being processed by the Shelf Controller.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID, FPGA) are connected permitting the Shelf Controller to acknowledge data (RI, Card type, Alarms..) from the board. It drives the PWR, MAB, DAB and leds.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

BMDX1100 buses and dedicated links

The V3A and V3B are duplicated Input power supplies (+3.7Vdc). They are combined on the unit using sharing diodes to provide a 3.3V DC power supply to SPIDER device.

The 48V_A and 48V_B are duplicated Input power supplies (–48Vdc or –60Vdc) compliant with ETS 300 132–2

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Measurement, Controls. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres Output signal carryies the Card Presence information. It is a dedicated (backpanel) wire between BMDX and Shelf Controller.

The GEN_APSD_OUT is an Output signal raised on RLL failure at the Demux input. It is used for safety reasons to provide automatic power shutdown (APSD) of an upstream amplifier. Backpanel links with the GENAPSD bus.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above a pre–defined threshold.

4.2.3.1 Frequency allocation

The following table details the channels multiplexed/demultiplexed at each input/output port of the BMDX1100 (see also Table 12. on page 129 for the frequency plan).

Table 17. Multiplxed/demultiplexed channels by BMDX1100 on 50GHz grid and band centre frequency

	Centre frequency / Centre λ	Port number
Band 1	195.7 THz/1531.898 nm	195.700
Band 2	195.3 THz/1535.035 nm	195.300
Band 3	194.9 THz/1538.186 nm	194.900
Band 4	194.5 THz/1541.349 nm	194.500
Band 5	194.1 THz/1544.525 nm	194.100
Band 6	193.7 THz/1547.715 nm	193.700
Band 7	193.3 THz/1550.918 nm	193.300
Band 8	192.9 THz/1554.134 nm	192.900
Band 9	192.5 THz/1557.363 nm	192.500
Band 10	192.1 THz/1560.605 nm	192.100
Band 11	191.7 THz/1563.862 nm	191.700
Band 10	191.3 THz/1567.132 nm	191.300

4.2.3.2 Brief description of the main features of BMDX1100

The **BMDX1100** is the 12:1 and 1:12 Band Multiplexer & DemultipleXer for Band OADM application.

4.2.3.3 BMDX1100 optical characteristics

See para. 5.3.2.3 on page 225.

4.2.3.4 Unit Start–up

4.2.3.4.1 Initialisation

On insertion of the BMDX1100 into the subrack, the shelf controller configures the provisionable parameters.

4.2.3.4.2 Unit Re–start after Replacement

Re–start as for initialisation

4.2.4 ALCT1010 (Automatic Laser ConTrol)

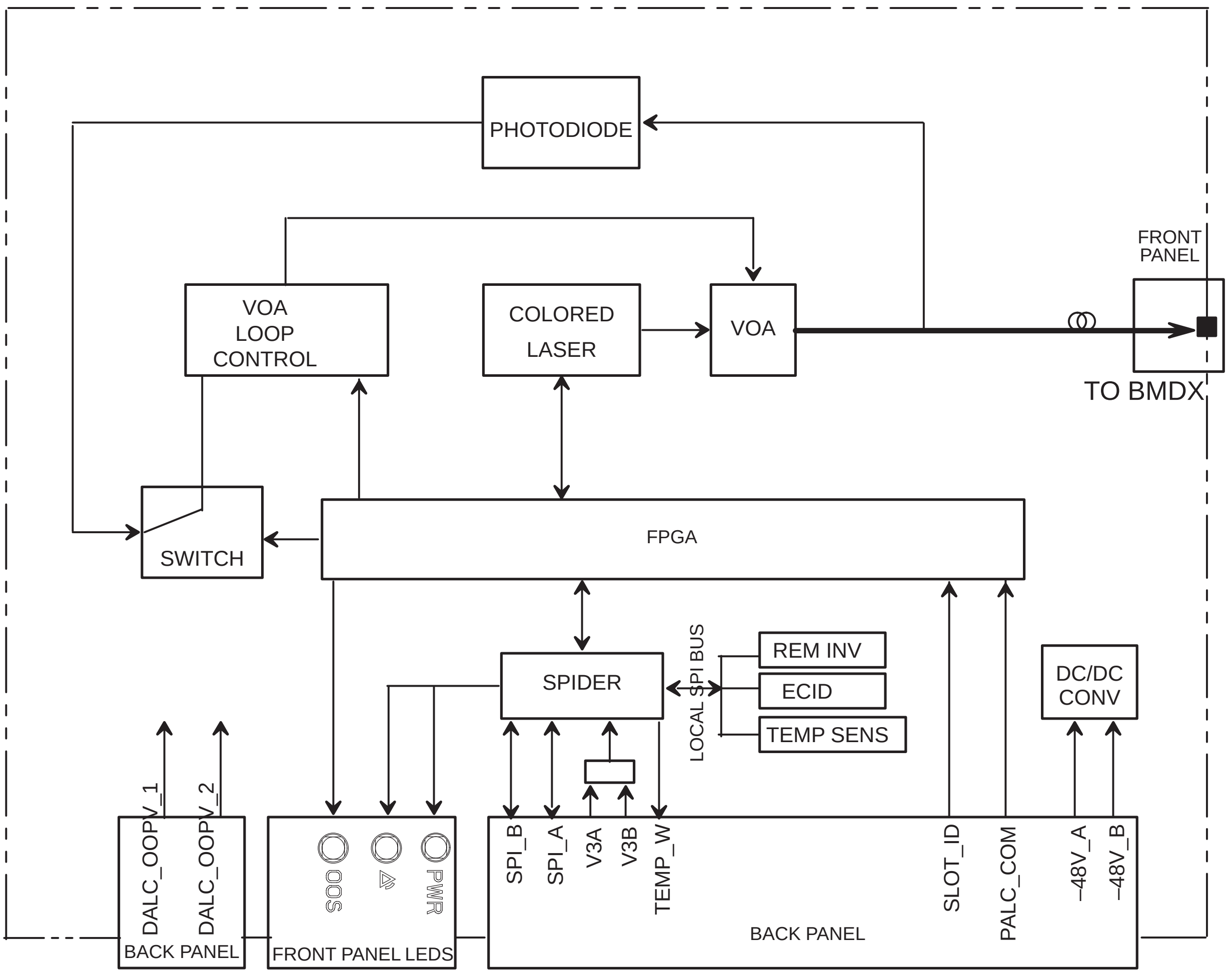


Figure 99. ALCT1010 block diagram

This unit is used in the 1626 LM equipment in order to maintain a constant optical power over the whole C+ Band.
It facilitates the system loading with a few number of modulated channels or the compensation of the loss of some modulated channels.

Each ALCT1010 unit is filled with one laser. In function of the line performances, more than one ALCT channel can be required. As the laser inside the unit is not wavelength–tunable, if more than one ALCT channel is required within the line, different lasers with different wavelengths have to be used inside the different ALCT units. The list of the wavelengths that can be used inside the board is given on TABLE XXX

This board contains two ALC loops (Laser + VOA +Photodiode)
- the DFB laser is used to provide a constant optical power of +13 dBm.
- the VOA allow an optical attenuation of 30 dB
- the internal photodiode is used to monitor the optical power at the output of the board and to regulate the output optical power.

The ALCT1010 board can be used in two different configurations
- Loading mode
- Dynamic mode

In Loading mode, the ALCT output power (the loop) is controlled via the electrical signal of the internal photodiode. The tuning is done with the OP_WDM_L provisionable parameter by the user or by the LALC algorithm. In that case, OP_WDM_L is the ALCT output power.

In Dynamic mode, the ALCT ouput power is controlled with a hardware loop from the BMDX output. In that case, the tuning is done with OP_WDM_D that is the BMDX output power target and that does not correspond to the ALCT output power. This loop control uses backpanel links.

At the user interface level, all ALCT units connected to the BMDX are managed together through the Automatic Level Control mode that relies on ALCT modes (Loading and Dynamic).

A low frequency modulation (60 kHz) is added to the wavelength in order to reduce stimulated Brillouin back–scattering. This feature is called SBS suppression.

The **FPGA** allows managing of all the alarms before being processed by the Shelf Controller. The OOS led (not used in current release) is managed by FPGA.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID, FPGA) are connected permitting the Shelf Controller to acknowledge data (RI, Card type, Alarms..) from the board. It drives the PWR,and leds.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

BMDX1100 buses and dedicated links

The V3A and V3B are duplicated Input power supplies (+3.7Vdc). They are combined on the unit using sharing diodes to provide a 3.3V DC power supply to SPIDER device.

The 48V_A and 48V_B are duplicated Input power supplies (–48Vdc or –60Vdc) compliant with ETS 300 132–2

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Measurement, Controls and tunings. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The DALC_OOPV_1 is an input backpanel signal used to measure the BMDX1000 or BMDX1100 output power from the adjacent left slot (in dynamic mode there are constraints on the location of the ALCT with respect to the BMDX, as shown on Table 11. on page 101). It provides loop control in dynamic mode.

The DALC_OOPV_2 is an input backpanel signal used to measure the coupler board output power from the below unit. It provides loop control in dynamic mode. For future release.

The PALC_COM is an input backpanel signal used to manage the ALC protection. For future release.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above a pre–defined threshold.

4.2.4.1 Frequency allocation

The ALCT1010 laser is not tunable, therefore one version exist to feed each of the 11 BMDX bands (ALCT in band 1 is not required).
The information on the emitted frequency is contained in the ECID. If the frequency required by the operator is not the one of the unit, the shelf controller shall declare a C_TYPE alarm.
The ALCT wavelength list is shown in Table 20. on page 226.

4.2.4.2 Brief description of the main features of BMDX1100

The **ALCT1010** provides automatic laser control. One board per each 8–channel sub–band.

4.2.4.3 ALCT1010 optical characteristics

See para. 5.3.2.4 on page 226.

4.2.4.4 Unit Start–up

4.2.4.4.1 Initialisation

Once plugged, before unit provisioning and cabling declaration, the laser is in OFF state and the VOA at the maximun of attenuation.
The laser is switched ON after the unit provisioning and after cabling declaration to the BMDX. During the switch–ON time, the VOA is at the maximum of the attenuation.

4.2.4.4.2 Unit Re–start after Replacement

All the provisioning of the unit that has been replaced are stored in SW so that they are downloaded to the new unit as soon as it is plugged.
During the laser switch–ON time, the VOA is at the maximum of the attenuation

4.2.5 LOFA11y0 (Line Optical Fiber Amplifier)

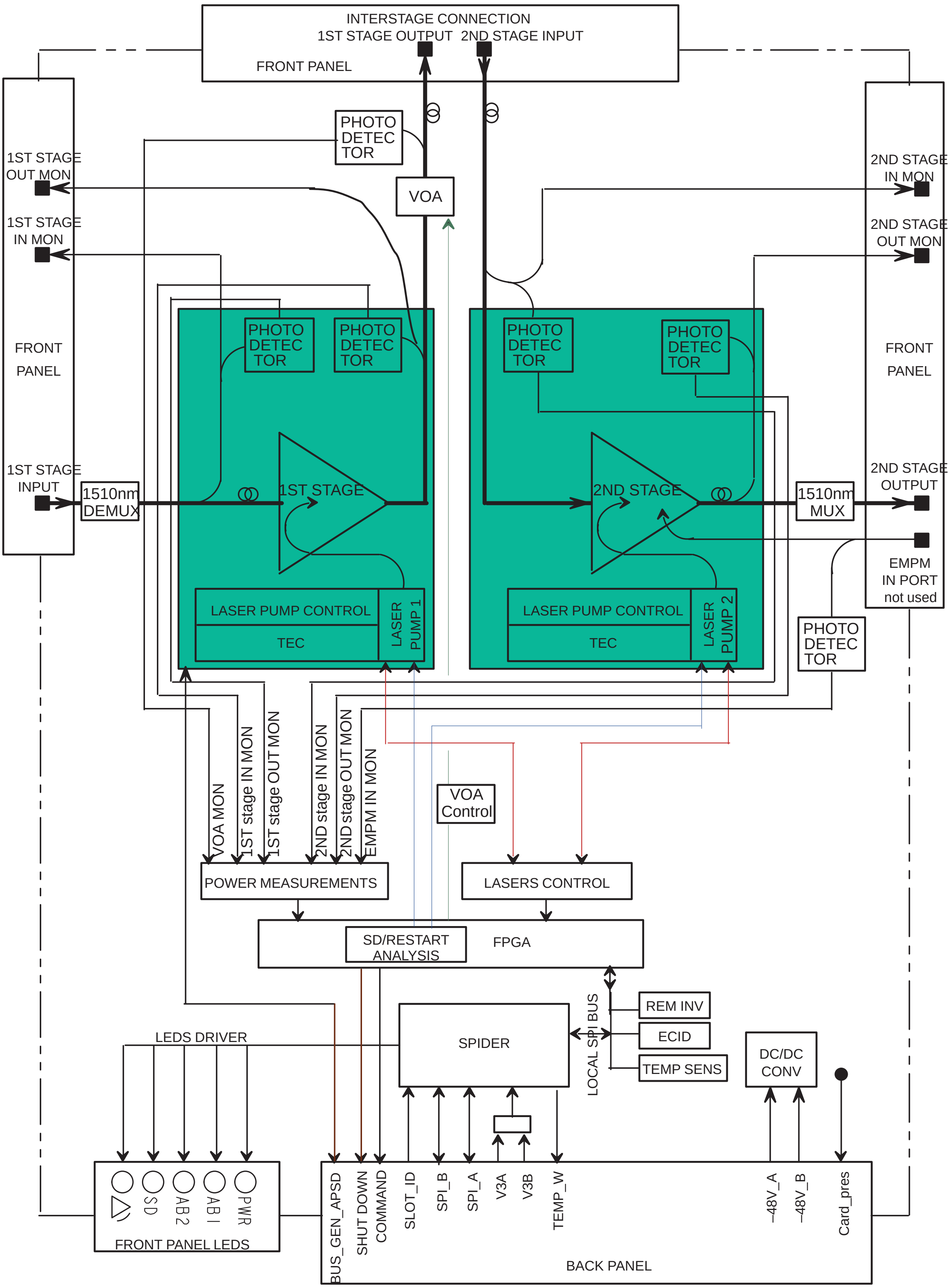


Figure 100. LOFA11y0 block diagram

Refer to Figure 100. LOFA11y0 is an extended C–band, dual–stage, erbium doped fiber amplifier.
It provides up to +20 dBm output power in extended C–band without External Multi–Pump Module and up to +23 dBm in C–Band with External Multi–Pump Module (EMPM). EMPM will be provided in future release.

At its optical 1st stage input is located a 1510 nm DEMUX, able to separate the 1510 nm supervisory information (OSC) from the aggregate/line signal in Extended C–band (up to 96 channels from 1530 nm to 1568 nm), that has to be amplified.
At its optical 2nd stage output is located a 1510 nm DEMUX, able to add the 1510 nm supervisory information (OSC) to the aggregate/line signal in Extended C–band that has to be sent to the line.

LOFA11y0 contains an internal tunable attenuator (VOA) in order to optimize the gain flatness during the life of the system and to avoid Non–linear effects in DCF that can fill the interstage.

The interstage of this amplifier can be filled with DCU (either DCF or HOM or any other technologies).
LOFA11yz unit is capable to tune automatically its VOA and its 1st stage output power. The dedicated mechanisms are embedded inside the FPGA.

Each gain block is monitored at its input and output and the relevant monitoring signals is made available on the front plate, by means of MU/SPC connectors.
A photo detector on each input/output electrically monitors the optical power level and sends the relevant infirmation to the FPGA, for signal processing.

Two laser pumps drive the current control loops.

LOFA amplifiers are tunable. In fact some parameters are provisionable by the operator as output powers (1st stage, 2nd stage...), ILOS1, OLOS1 and 2 alarms, VOA and APSD parameters.

LOFA11y0 supports 2 functional variants
– LOFA1110 is a 22/9 amplifier. This means that when the interstage is filled with 9 dB insertion losses, the nominal gain of this EDFA unit is 22 dB.
– LOFA1120 is a 28/9 amplifier. This means that when the interstage is filled with 9 dB insertion losses, the nominal gain of this EDFA unit is 28 dB.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus (local SPI bus) on which the memories (remote inventory, ECID, FPGA..) are connected permitting the Shelf Controller to acknowledge the following data from the board
– unit identity data from Remote Inventory EEPROM (mnemonic, part number, company id...)
– unit specific data from ECID (card type..)
– configuration, tunings, monitoring, alarms from FPGA; it also manages the APSD process
The Spider also drives the front panel leds.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

LOFA11y0 buses and dedicated links

The V3A and V3B are duplicated Input power supplies (+3.7Vdc). They are combined on the unit using sharing diodes to provide a 3.3V DC power supply to SPIDER device.

The 48V_A and 48V_B are duplicated Input power supplies (–48Vdc or –60Vdc), compliant with ETS 300 132–2

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Measurement, Controls and tunings. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres Output signal carryies the Card Presence information. It is a dedicated (backpanel) wire between LOFA and Shelf Controller.

The BUS_GEN_APSD is an I/O bus for the APSD management, indicating optical LOS of LOFA1 first stage. It is used for safety reasons to provide automatic power shutdown (APSD).

The OTS_FAIL Output signal indicates OSCU that a failure has been detected, via back panel bus.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above a pre–defined threshold.

4.2.5.1 Brief description of the main features of the LOFA

The **LOFA1110** is a EDFA double–stage line/aggreagate amplifier with VOA at the 1st stage output. With 9 dB insertion loss the nominal gain is 22 dB.

The **LOFA1120** is a EDFA double–stage line/aggreagate amplifier with VOA at the 1st stage output. With 9 dB insertion loss the nominal gain is 28 dB.

4.2.5.2 LOFA11y0 optical characteristics

See para. 5.3.2.5 on page 227.

4.2.5.3 Optical safety

See para. on page .

4.2.5.4 Unit start–up

4.2.5.4.1 Initialisation

LOFA11y0 automatically tunes itself to its default settings

- Default Configuration is double stage mode.
- Output power tuning :
  - 2nd stage output power
  - VOA tuning (VOA default setting, 9 dB, then MSV algorithm)
  - 1st stage output power tuning according to OP_DIFF parameter.

4.2.5.5 Unit re–start after replacement

LOFA11y0 provisionings are stored inside software so that, in case of restart after replacement, LOFA11y0 tunes itself to its previous nominal settings.

4.3 Controllers

4.3.1 ESCT1000 (Equipment and Shelf ConTroller)

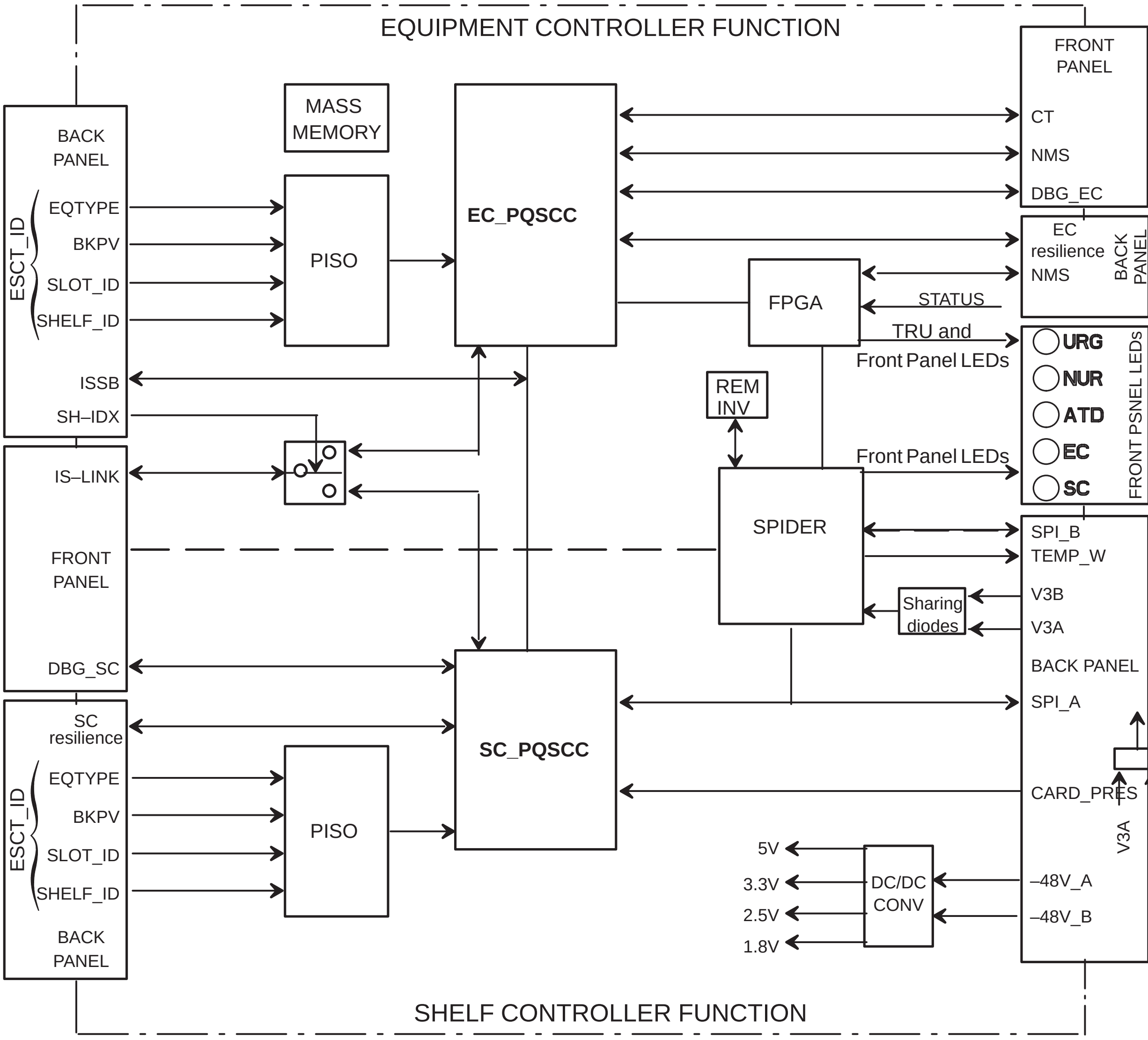


Figure 101. ESCT1000 block diagram

The ESCT1000 (Equipment and Shelf Controller) board is the hardware platform designed to support the Equipment Controller (EC) function and the Shelf Controller (SC) function for the 1626 Light Manager.

ESCT1000 board is in charge of the internal management of the node. It dispatches controls received by management system to appropriate board, check consistency between expected configuration and the actual one and finally reports alarms, performance counters and measurements.
There is one active equipment controller in each node and one active shelf controller in each shelf. Equipment Controller manages Shelf Controllers.

The EC function is in charge of processing the activities concerning the “Virtual Equipment Control Element” (VECE) function:

– Virtual Machine Management Function (VMMF)
– Message Communication Function (MCF)

The SC functions is in charge of processing the activities concerning the “Physical Equipment Control Element” (PECE) function:
– Physical Machine Management Function (PMMF)
– Basic Process Control Function (BPCF)
It provides the resources to support the SW functions related to the physical machine control and management and configuration provisioning.

When the ESCT board is located in the master shelf, both EC and SC functionalities are provided.
When the board is located in slave shelves, only the SC functionality is provided. EC functionality can be activated too in order that FPGA can read TDM links (DCC written by OSCU, future rel.).

ESCT1000 located in the master shelf supports a PCMCIA containing software applications and used as a data base. The PCMCIA can be extracted from ESCT in order to plug it in another unit and to provide the new unit with the data base.
As a consequence, only one ESCT1000 in the NE supports a mass memory but the EC functionality can be activated in several ESCT1000s : EC functionality is indeed required to read the TDM back panel links..

The ESC consists in a double processor board. It is mainly composed of :
– A ESCT mother board,
– A daughter board achieving the EC function,
– A daughter board achieving the SC function,
– A non volatile mass storage.

Each of these functions (EC and SC) are realized using a PQSCC daughter board. They are plugged on the ESCT mother board. The PQSCC module is developed in order to provide a common HW (and SW) platform for different applications requiring a Shelf Controller or an Equipment Controller function.

An EEPROM is used to store the local configuration of the NE when EC platform is activated. The local configuration is required to allow the NE management : it contains the adresses, time protocol informations, LAPD configurations...
This EEPROM is accessed by EC processor (EC_PQSCC) via the LCI link. It is a non volatile memory so that in case of Data Base reset, the information it contains is not reset and can be uploaded to the PCMCIA (in which the data base is stored) if needed (DB reset with upload).

Various kinds of serial communication channels and parallel I/O ports for alarm & status signals are provided by the ESCT1000 card.

The **SPIDER** provides the front–end interface to the SPI bus. The SC processor is master of the ”SPI” interface and uses this bus to access all slave boards in the shelf through SPIDER components placed on them. Its main features are: reading the remote inventory memory devices, access the parallel I/O functions on slave boards, control the unit’s alarm leds, collection of card status and static alarms , access the FPGAs on boards and update their firmware.
The **FPGA** on the ESCT1000 board is accessible as a slave device by the SC processor through the SPI interface. The FPGA has some parallel I/O ports (available from the EC function) providing the following functions: front panel leds control, front panel switches status, equipment internal alarms collection, status information collection, card internal functions.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

ESCT1000 buses and dedicated links

SC part / local board management

The SPI_A bus is an I/O backpanel bus, used for Alarms gathering, Measurement, Controls and tunings. It is linked to the slave boards, the bit rate is 500Kbps

The SC_DBG is an I/O RS–232 asynchronous serial channel used for SC debugging. It is available on the front plate of the board (RJ45 connector), the bit rate is 38.4Kbps.

The SC resilience is an I/O backpanel link allowing the active / stand–by SC interprocessors link in the same shelf (future release).

SC part for each slave board management

The Card_Pres is an Input backpanel signal carrying the Card Presence information.

EC part

CT is the Q3/TL1 I/O interface toward the local Craft Terminal (F interface). It is a 38.4 kbit/s serial RS232 interface with a DB9 connector

NMS is the Q3/TL1 I/O interface toward the Network Management System (NMS). It is a 10 Mbps Ethernet (10 Base–T/10 Base–2) interface, available on the front panel, by means of RJ45 and BNC connectors.

TDM is a Time Division Multiplexing bidirectional link toward TRBD/OSC. It is a 2.048 Mbps backpanel link (future release).

The SPI_B bus is an I/O backpanel bus at 500Kbps, used for Remote access.

The EC_DBG is an I/O RS–232 asynchronous serial channel used for EC debugging. It is available on the front plate of the board (RJ45 connector), the bit rate is 38.4Kbps.

The EC resilience is an I/O backpanel link allowing the active / stand–by EC interprocessors link in the same shelf.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above the limit. It is launched when the N_WARNING alarm is raised on the board.

Common part

The ESCTID is an Input backpanel signal carrying the EC and SC identification information: equipment type, backpanel version, slot identifier, shelf identifier.

The ISSB bus is an I/O backpanel bus at 5 Mbps, connecting the EC with the local SC and the main ESCT with the protecting one (when the ESCT board is duplicated).

The IS–LINK is an I/O inter–shelf bus. It is a 10 Mbps Ethernet channel, connecting the EC with the all the SCs of the NE, located in separate shelves. It is available on the front plate of the ESCT board, by means of the BNC (10Base–2 interface) or RJ45 (10Base–T interface) connectors.

4.3.2 XTID1000 (eXTended ID 1000)

The aim of this unit is to give to ESCT (EC and SC) mandatory informations allowing the system to work properly. There is one eXTended ID unit per 1626 LM shelf.
The information contained by the slot 27 card are part of ESCT_ID (see the previous para. 4.3.1) and are necessary to configure the ESCT1000 unit.

Regarding these “hardware” information, the eXTended ID1000 unit can be considered as a hardware extension of the back panel; these informations are provisioned before the system starts up and cannnot be modified without a user manual intervention.
Moreover it is not required a software management : ESCT software directly reads them.

The following parameters of ESCT_ID are supplied to ESCT by the eXTended ID unit :

– EQUIPMENT_TYPE: it is a 4 bits word (1626 LM = 1010)

The type of equipment is determined by reading both EQ_TYPE and BKPV (the last one is provided by ESCT1000).

– SHELF_ID : it is a 8 bits word giving the position of the shelf in the NE
  - the 1st bit is unused : SHELF_ID = X.
  - the seven following bits, give the position of the shelf in the system, allowing to configure up to 256 shelves:
    – the first shelf is the master shelf, with SHELF_ID = X0000001
    – the second shelf has SHELF_ID = X0000010 and so on for all the other shelves.

4.3.3 OSCU1010 (Optical Supervisory Channel Unit)

The OSCU board is used for the management of the supervision channel, transported over a 1510nm extra–band wavelength with a 4.864 bit rate being the result of the multiplexing of two 2.048 Mbps streams: the 2 Mbps OSC frame and the 2 Mbps service channels (UDC, future rel.).
The board provides two optical transmitters and two optical receivers enabling to supervise two directions.

The OSC stream, contains the LAPD communication protocol with the ESCT in the 12 Data Communication Channel bytes; furthermore, the E1 byte of DCCs carries a 64 Kbps voice channel, dropped in a telephone handset through a jack connector (front panel), allowing to call all the NEs linked to that one with the OSC.
The other stream is the User Data Channel (UDC); it can be used by the customer as he wants.

The OSC channel is managed by the OSCU unit. It is inserted at the output of the terminal equipment (input of the WDM line), dropped in each OADM or back–to–back terminal or In line repeater, and re–inserted on the other side of the NE. Hence the OSC is propagated from NE to NE, extracted in each NE by the OSCU unit and transmitted to the Equipment Controler (EC) by means of the ESCT board to be analysed.

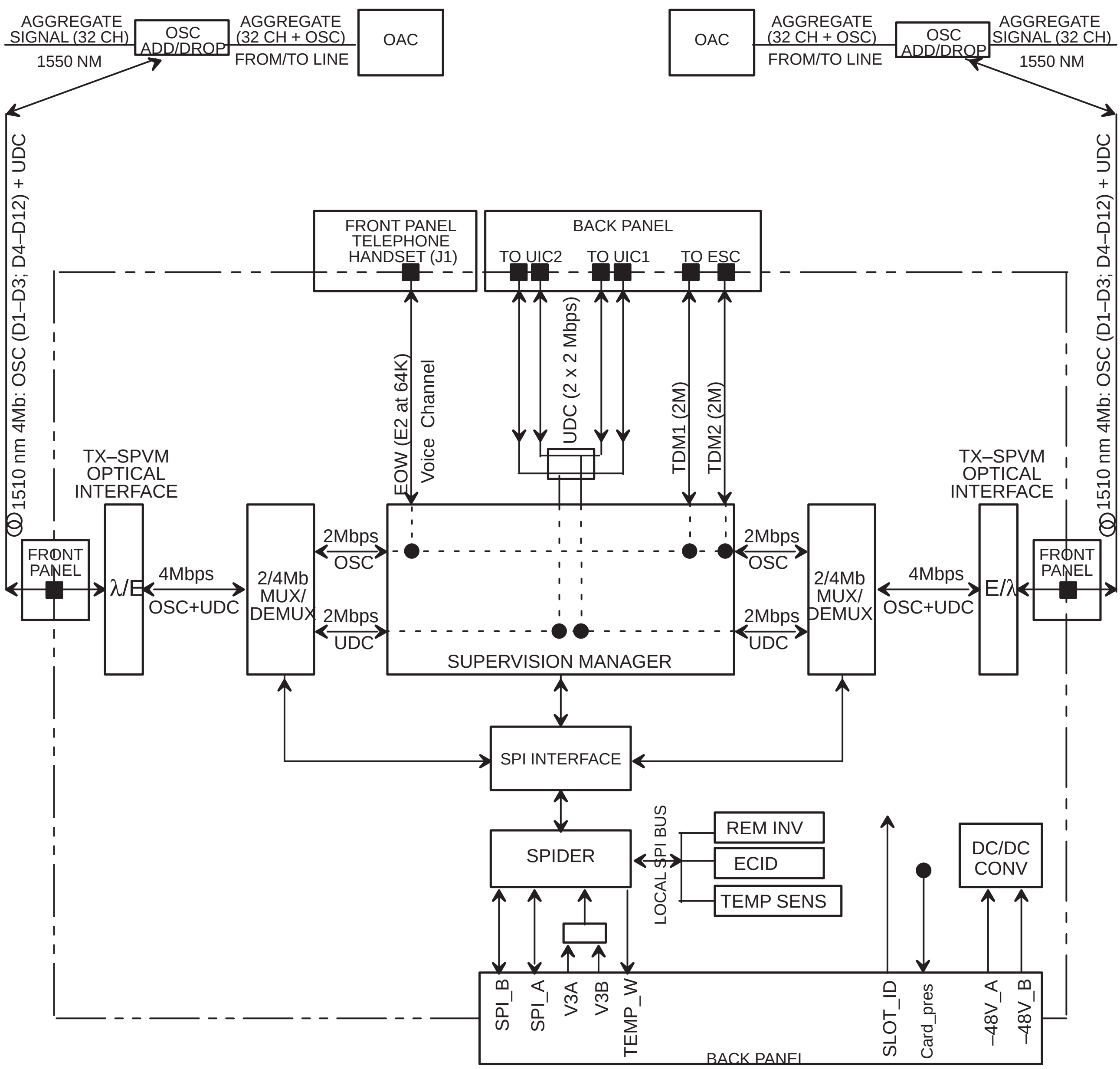


Figure 102. OSCU1010 block diagram

The supervisory channel path is bidirectional.
At first, the 4Mbps signal (OSC + UDC) on a 1510 nm wavelength, is extracted from the optical aggregate signal with an optical filter, in amplifier or mux/demux board. Then it is received by the OSCU board and electrically demultiplexed in two 2 Mbps streams: the 2 Mbps UDC stream and the 2 Mbps OSC stream.
The 2 Mbps user data channel is sent to the USIB (future rel.) board through back panel links to be dropped to the client.
The 64 Kbps E2 byte carrying the voice channel, is dropped towards the board front panel on which a telephone handset is plugged.
The DCCs are sent with the entire 32 bytes frame through back panel TDM links to the ESCT board located in slot #1. The FPGA extracts the DCC bytes and stores them in registers. Al the processing are pèrformed by the microprocessor.

In the reverse way, the microprocessor generates the information to be sent, gives it to the FPGA that builds the 32 bytes frame. This frame is sent to the OSCU board through TDM links.
The OSCU board fills the 64 kb/s E2 voice channel.
It fills the UDC with the stream coming from the USIB (future rel.).Then it multiplexes the 2 Mbps supervisory channel with the 2 Mbps user data channel. The laser emits the 4 Mbps OSC frame that is multiplexed through an optical filter in an amplifier board (LOFA) or Mux/Demux (BMDX).

OSCU1010 main features

The OSCU unit is used to manage supervision (OSC) and service channels (UDC).
The set of service channels is a subset of the section overhead of the STM1 frame, as defined in ITU Recommendation G958 (1994) [2]. The unit is able to multiplex/demultiplex the optical service channels in 2048 kbps or 4864 kbps proprietary supervision frames.
In case of a 4864 kbps frame, the OSCU multiplexes/demultiplexes it in two 2048 kbps frames, only one of these contains the supervision information (OSC), the other is an extra traffic frame (UDC).
Moreover the OSCU unit is used for alarm and status collection from the optical units in the shelf.

The main features provided by this unit are the following

– management of up to 2 bidirectional supervision streams (OSC) at 2048 kbps (2 supervision ports): one for Line terminal application and one for each side of the link in back–to–back or OADM application

– multiplex/demultiplex of the 4864 kbps streams in two 2048 kbps streams (OSC + UDC)

– management of two bi–directional 2 Mbps Data Communication Channel, TDM1 and TDM2; these data streams are made available to the ESCT via a backpanel bus, and are used for network management

– management of four 2.048 Mbps auxilliary channels (UDCs), from/to USIB boards (future rel.)

– Matrix interconnecting 2048 Kbps channels: two OSCs, four UDCs, four DCCs (TDM1/2) for ESCT (2+2 protection), two channels linked to the mux/demux circuits, six 2 MHz bus to interconnect OSCU

– management of E2 audio channel: the default configuration enables to drop the audio channel towards a jack connector on the front of the unit to connect a telephone handset, allowing to call a specific NE or to make a conference call. The phone number of the NE is set with the two front panel coding wheels

– management of K1/K2 in 2 Mbps TDM streams; this data is made available to the ESCT.

4.3.3.1 OSCU1010 main blocks functionalities

2/4 Mbps MUX/DEMUX: it is a gate array that mux/demux a 4864 kbps stream into two 2048 kbps streams.

The Supervision Manager includes Matrix and Supervision frames and service channel management functionalities. It mainly provides

– service channel multiplexing and demultiplexing
– service streams K1/K2, DCC1 and DCC2 management
– access to four user auxiliary 2048 kb/s streams
– Matrix function between the 2048 kb/s streams

The Matrix provides matrix function among the four 2048Kbps channels, the streams of the supervison channels processed by the 2/4Mbps mux/demux and 2 internal streams reserved to the mux/demux of service channels contained in the supervision channels.
The Supervision frames and service channel management extracts/inserts the slots containing E2 from the supervision frames. TDM frames, which are supervision information, coming from both sides (EAST and WEST) are re–routed to the ESCT board.

SPI interface : it permits to the application software to configure the OSCU.

TX–SPVM Optical interface : it is an optical transceiver.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID) are connected permitting the Shelf Controller to acknowledge data (code identification, serial number, ICS, Card type, presetting data, Alarms..) from the board.

POWER SUPPLY. Two external 48V supplies are sourced from the back–panel providing supply redundancy. The card includes fuses in the 48V supply. All components on the card are powered from the 48V supply via a DC/DC converter or an additional step down supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

4.3.3.2 Brief description opf the main features of OSCU1010

The OSCU1010 board provides insertion/extraction of the supervision channel (OSC) and the user data channel (UDC) on a 1510 nm wavelength (bit rate = 4.864 Mbps).

4.3.3.3 Optical characteristics

See para. 5.3.2.6 on page 228.

4.3.3.4 Functional Description of the configurations

As described on two following figures the data of OSC channel at 1510 nm are sent to the matrix into a 2 Mbps signal to the supervision frame management functional block. This block generates one/or two TDM signals according to the NE configuration.

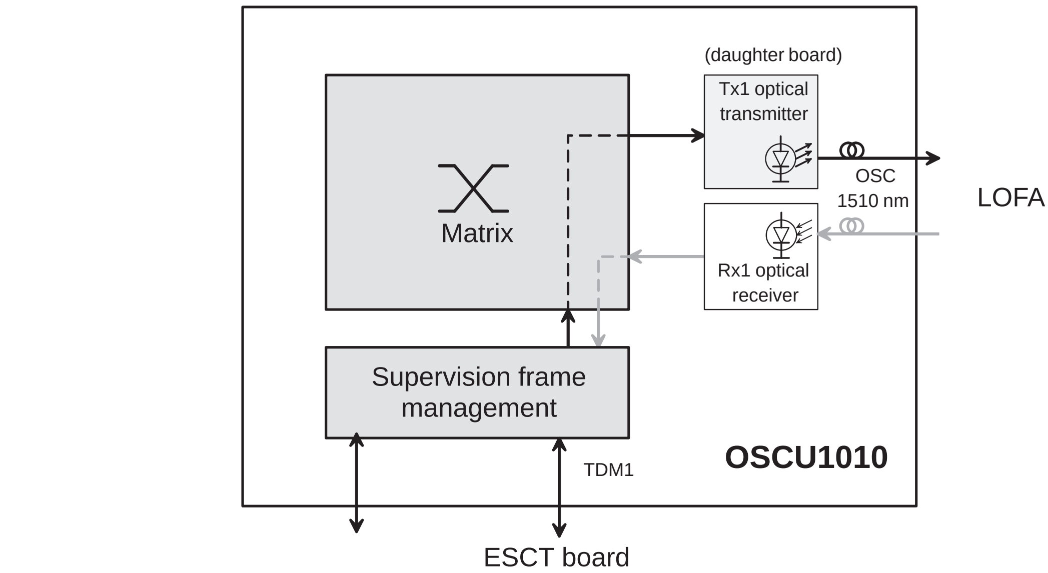


Figure 103. SPVM board in a Line Terminal configuration

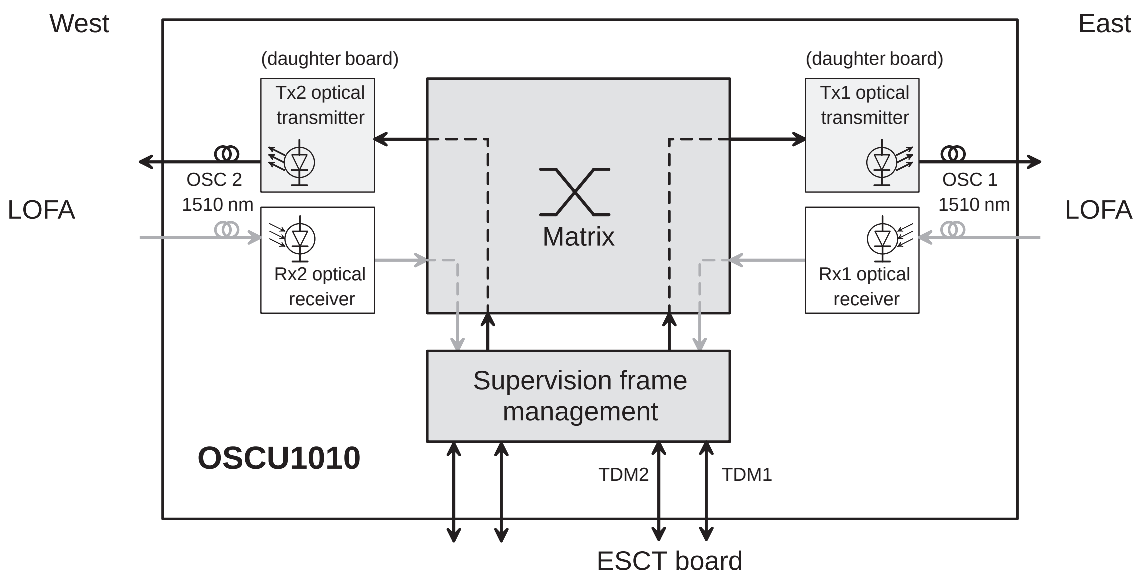


Figure 104. OSCU board in an OADM or Back–To–Back configuration

N.B. When the network comprises NEs connected in a ring, at least one NE must be configured with the OSCU board in "**Local Clock**" configuration (to avoid clock loop). OSCU board for the others NE can be configured in "**Remote Clock**" configuration.

User channels

The 2Mbps and 64Kbps channels exchanged with USIB, are drop–insert connected by default (future rel.).

4.3.4 HSKU1000 (HouSe Keeping Unit)

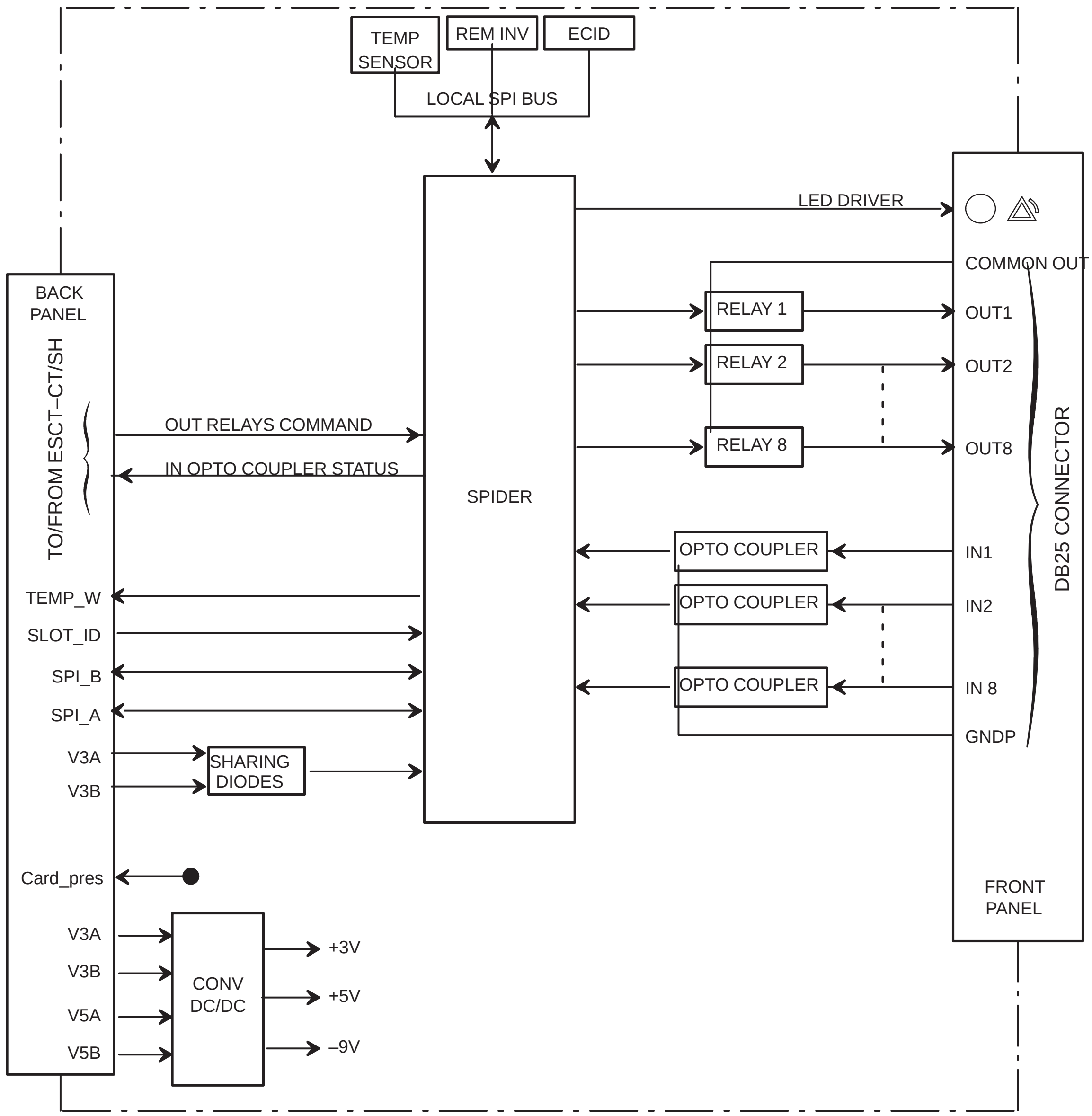


Figure 105. HSKU1000 block diagram

The 1626 LM system is able to interface itself with user's environment and/or another 1626 LM system to build up maintenance operations by means of the HSKU (House Keeping unit).
Its main purpose is to send and receive data from/to master cards via SPI bus, and from/to the user or another 1626 LM system throughout protected I/O interface.

The HSKU1000 allows the user to manage some electrical relays and opto–couplers through the Craft/SH in order to command remotely some devices external to the 1626 LM. The user is thus able to

- be informed of the status of the input opto–couplers
- remotely change the state of the output relays.

Each HSKU1000 board provides 8 output relays and 8 input opto–couplers.
The status of the OUT relays can be managed (Open/Close) through the SW separately for each relay.
The IN opto–couplers status can be raised by the board to the SW separately for each opto–coupler.

As regards the opto–couplers, the Shelf Controller poll them (IN1 to IN8) regularly, and then this information is immediately transferred to the Equipment Controller and notified to the management interface.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID) are connected permitting the Shelf Controller to acknowledge data (code identification, serial number, ICS, Card type, presetting data, Alarms..) from the board.
It drives the Green/Red led of the board ( ).

POWER SUPPLY. Two external voltages V3A/B and V5A/B are supplied by PSUP1000 unit to generate 3 internal voltages VC3V, VC5V and VN9V (negative 9 volts), via a DC/DC converter.
The SPIDER device which is supplied via the external backplane 3.3V supply.
On–board fuse protection, power supply measurement and failure control are available.
The Alarm interface manages, via SPIDER, all the power supply alarms: V3A, V3B power supply from the backpanel and –9V power supply from the DC/DC converter.

HSKU1000 buses and dedicated links

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Controls and tunings. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Card_Pres is an Output backpanel signal carrying the Card Presence information.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above a pre–defined threshold.

OUT1 to OUT8 are OUTPUT signals of the relays, available on the 25–pin female connector, located on the front plate.
A Common output is the reference signal for OTU1 to OUT8 output relays signals, available on the 25–pin female connector on the front plate.

IN1 to IN8 are INPUT signals of the opto–couplers, available on the 25–pin female connector, located on the front plate.
An Input GNDP is the reference signal (ground) for IN1 to IN8 output opto–couplers signals, available on the 25–pin female connector on the front plate.

4.3.4.1 HSKU1000 electrical characteristics

See para 5.1.1 on page 209

4.3.5 RAIU1000 (Rack Alarm Interface Unit)

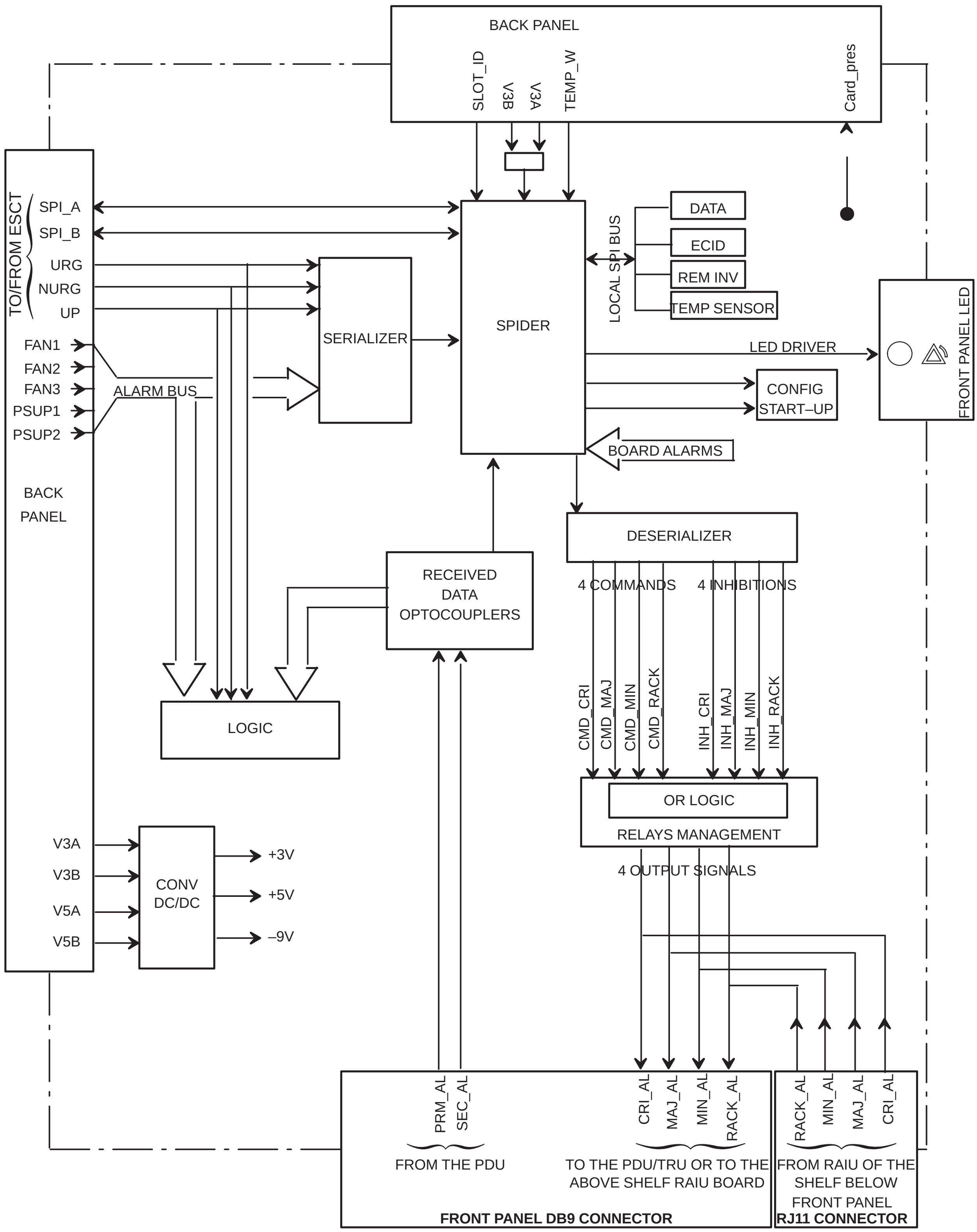


Figure 106. RAIU1000 block diagram

The RAIU1000 board monitors the rack alarms to light On or Off the lamps of the top rack unit.
Each shelf of all the racks (master and secondary shelf) is equipped with one RAIU1000 which collects information on the alarms raised in the shelf.
This unit allows to exchange the alarm signals between the ESCT or the Alarm Bus (FANS and PSUP alarms) and the TRU.
These alarms are analysed either by the ESCT board or directly by the Alarm card (RAIU1000). In function of the emergency of these alarms, the ESCT generates signals to turn on LEDs on the or TRU and so to alert users.

The RAIU of the slave shelf only takes into account:
– the alarms raised by the fan modules or by the power supply units of the shelf via the ALARM bus
– the information sent by the RAIU board of the below shelf when present.

The RAIU board of the master shelf collects signals:
– from the ESCT via the SPI bus
– from the EC via the URG, NURG and UP signals
– directly from the fan modules and from the power supply units of the shelf via the ALARM bus
– from the RAIU board of the shelf below.

The RAIU board located in master rack is connected to the top rack unit, as shown on Figure 107. on page 203. Inter shelf communication between RAIU boards is managed via an external cable on the front panel.

Main RAIU1000 functionalities:
– management of four output alarm signals to be sent to the TRU: CRI_AL, MAJ_AL, MIN_AL and RACK_AL;
– back panel connection to/from the ESCT board via the SPI bus for alarm commands (CMD_CRI, CMD_MAJ, CMD_MIN, CMD_RACK) or inhibition (INH_CRI, INH_MAJ, INH_MIN, INH_RACK);
– back panel connection from the ESCT board via the URG/NURG/UP wires;
– back panel connection from the 3 FAN modules and the 2 PSUP slots via the ALARM bus (1 more wire reserved for future used).
– two connectors are located on the front plate of the RAIU1000 with the following target
    • DB9 connector has to be connected either with the TRU or another RAIU board (on RJ11)
    • RJ11 connector has to be connected with another RAIU board (on DB9).

Note that the alarms of the URG/NURG/UP wires and of the ALARM bus (FANS and PSUP) are made available on the SPIDER, so that the SC can read them by the SPI bus and take them into account in its alarm synthesis to raise the appropriate command (CMD_CRI, CMD_MAJ, CMD_MIN, CMD_RACK).
It is possible to stop (inhibit) an alarm, sending the appropriated INH data to the Alarm card. So only the related commanded LED is turned off. If another alarm is detected by the ESCT, the appropriated signal can be sent to the Alarm card which could command the linked LED excepted if it was inhibited LED.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID, Data, serializer..) are connected, permitting the Shelf Controller to acknowledge the following data :
– code identification, serial number, ICS... by means of the Remote Inventory EEPROM
– board identification and presetting data of the board by means of the ECID EEPROM
– Alarm data from backpanel connector by means of the Serializer
– the 4 outputs (alarms) sent to front panel connector and to the SPIDER for monitoring, via deserializer

It drives the Green/Red led of the board ( ).

POWER SUPPLY. Two external voltages V3A/B and V5A/B are supplied by PSUP1000 unit to generate 3 internal voltages VC3V, VC5V and VN9V (negative 9 volts), via a DC/DC converter.
The SPIDER device which is supplied via the external backplane 3.3V supply.
On–board fuse protection, power supply measurement and failure control are available

RAIU1000 buses and dedicated links

Common part (electrical connectors)

The DB9 female connector, located on the front plate, allows

– Output connection with TRU and the above RAIU board

The RJ11 connector allows Input connection from the below RAIU board. It is located on the front plate.

For board management

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory, Alarms gathering, Controls and tunings. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Card_Pres is an Output backpanel signal carrying the Card Presence information.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The TEMP_W is an Output backpanel command to a FAN module to set its rotation speed in case of the board temperature is above a pre–defined threshold.

For alarm management

The Bus_ALM backpanel bus is an Input 6–wire bus coming from the FAN board (3 FAN modules) and from the 2 power supply units (+1 wire for future use).

The URG is an Input backpanel signal carrying the Urgent Alarm information, coming from ESCT1000.

The NURG is an Input backpanel signal carrying the Not Urgent Alarm information, coming from ESCT1000.

The UP is an Input backpanel signal carrying the Alimentation Alarm information, coming from ESCT1000.

4.3.5.1 Alarm management

The back panel wires (URG / NURG / UP and the ALARM bus) are sent to a first logic sub–unit whose four output signals are connected to an OR logic module, which uses also as input signals four signals from the SPIDER to determine the status of each one of the four relays used to command the rack lamps
– URG / NURG / ATTD, with TRU using.
If the RAIU boards of a rack are linked together, the four signals coming from another RAIU are also taken into account.

The four alarm signals sent to pilot the relays, are based on the following logics:
– CRI_AL On, if CMD_CRI or URG
– MAJ_AL On, if CMD_MAJ or UP or at least 2 FANs in failure
– MIN_AL On, if CMD_MIN or NURG or 1 FAN in failure
– RACK_AL On, if CMD_RACK or PRM_AL or SEC_AL (or FAN_AL, not managed in 1626 LM).
Generally speaking, a critical, major or urgent alarm is traffic affecting.

Table 18. Front Panel LEDs severity meaning

Severity		LED color	Meaning
CRITICAL	URGENT	RED	Critical/urgent alarm: immediate corrective action is required
MAJOR			Major/ugent alarm: urgent corrective action is required
MINOR	NOT URGENT	RED	Minor/not ugent alarm: corrective action should be planned in order to prevent more serious fault.
ATTENDED	WARNING	YELLOW	Rack Alarm: Indication of an existing fault. Further diagnosis should be made.

4.3.5.2 Interconnection with TRU

In current release, the 1626 LM is used with
– the Top Rack Unit (TRU), in ETSI market
The RAIU board interfaces the TRU.

Three types of cables are defined to be used with the RAIU:
– to interconnect with another RAIU, a DB9 – RJ11 cable is needed
– to interconnect with the TRU, a DB9 – DB25 cable is needed.

Interworking with the TRU

The RAIU boards can be chained as described previously, or can be directly connected to the TRU which has four DB25 connectors, as shown in Figure 107. on page 203).
The RAIU board manages the three leds of a TRU: URG (urgent) alarm, NURG (non urgent) alarm and ATTD (attended) alarm.
N.B. The TRU does not send information to the RAIU board.

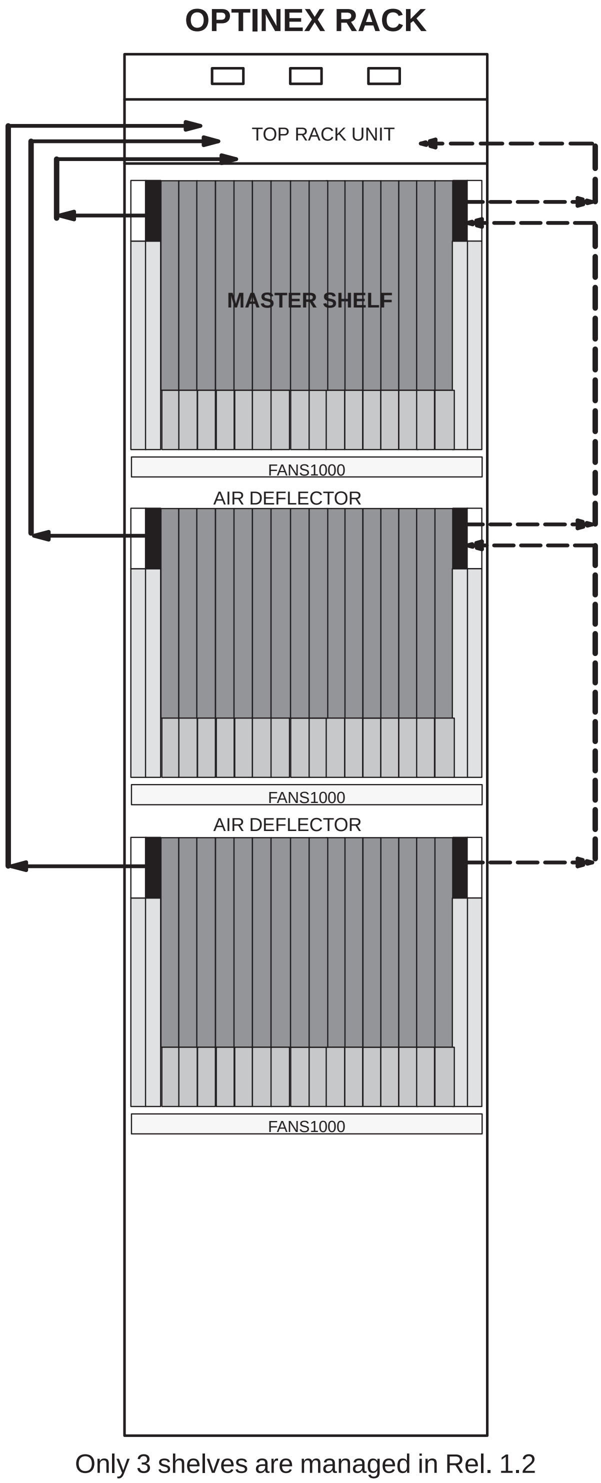


Figure 107. Electrical links between RAIU cards and TRU

4.4 PSUP1000 (Power SUPply card)

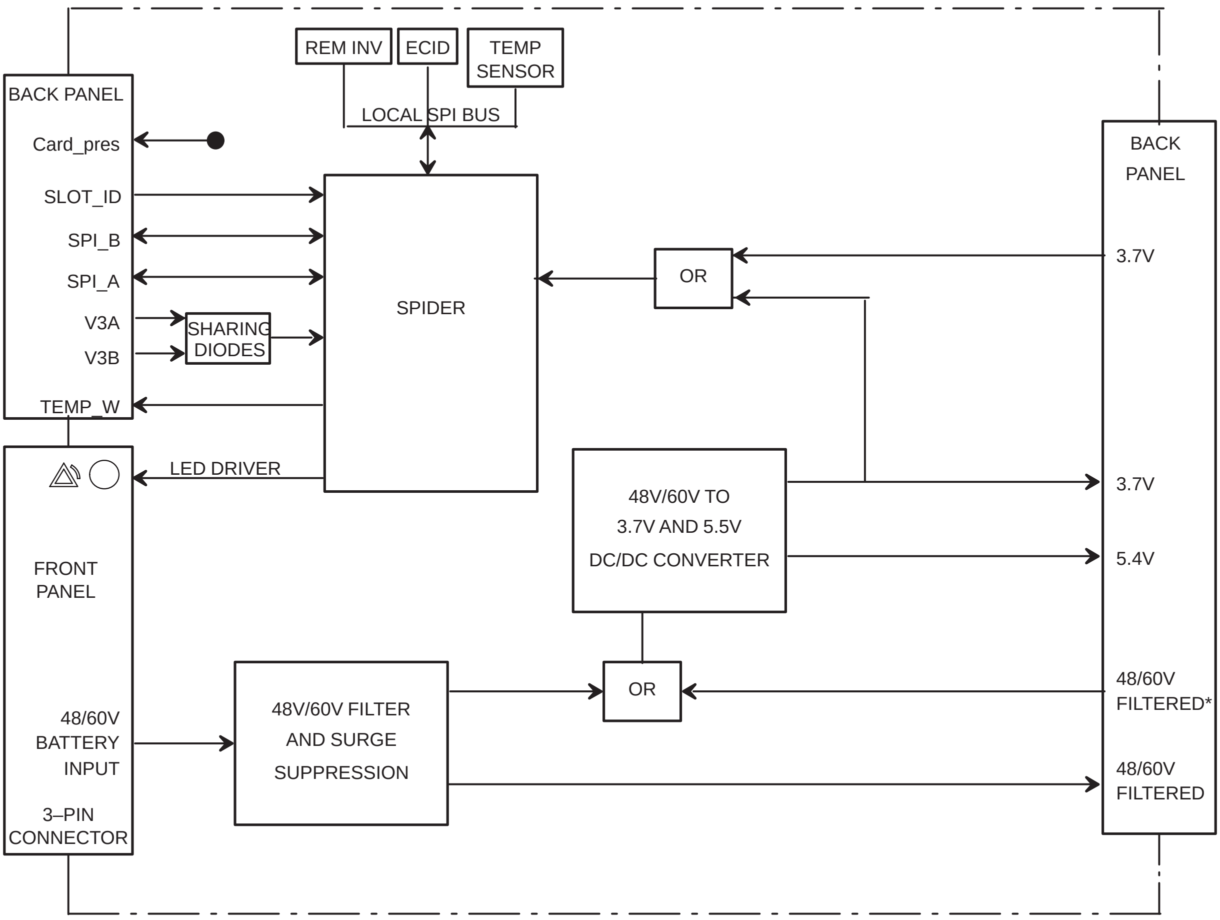


Figure 108. PSUP1000 block diagram

The power supply units PSUP1000 work in a 1+1 protected manner to provide the other units in the subrack with nominal 48 V (or 60 V), 3.3 V and 5 V supplies.
The majority of units within the subrack derive their own main supply voltages from this protected 48V (60V) supply, (by using on–card DC–DC converter).

The 3.3V supply is used to power the SPIDER interface and the Remote Inventory memory devices connected to the SPI bus on all the units in the subrack.

The 5.0V supply is also distributed to all units within the subrack, and is typically used by utility units (RAIU1000, HSKU1000).

The output voltages from the PSUP1000 requires to be 3.7V and 5.4V (for 3.3 and 5.0V respectively). This is due to the fact that two PSUP1000 are used in each subrack and the outputs of each are combined on each unit via diodes. The output levels of 3.7V and 5.4V allow for the voltage drop through these diodes.

The PSUP1000 power supply units also provide filtering and surge suppression of the incoming 48V (or 60 V) supply prior to be distributed to other units within the subrack.

The LOW (–48V) operational input voltage range is –40.5V to –57V.

The HIGH (–60V) operational input voltage range is –57 to –72V.

From 0V to –75V input voltage range, must not sustain damage over this range; ref ETS 300 132–2.

The PSUP1000 is also required to provide terminations for the ISSB bus and SPI bus (TX side).

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID) are connected permitting the Shelf Controller to acknowledge data (code identification, serial number, ICS, Card type, presetting data, board alarms..) from the board.
The board alarms are mainly referred to 48V, 3V, and 5V power supplies failure, fuse failure, over temperature...
It drives the Green/Red led of the board ( ).

PSUP1000 buses and dedicated links

The 48/60V_Batt is the 48Vdc/60Vdc input battery power supply, coming from the 3–pole front panel connector.

The 48/60V_filt is the 48Vdc/60Vdc output filtered power supply sent to the other boards in the shelf, via backplane.

The 48/60V_filt* is the 48Vdc/60Vdc input filtered power supply coming from the other PSUP to feed DC/DC converter, via backplane.

The V3A is the +3.7Vdc power supply for SPIDER. It is combined with V3B on the unit using sharing diodes to provide a 3.3Vdc power supply. It is an Output signal also sent to the other PSUP, via backpanel.

The V3B is the +3.7Vdc power supply for SPIDER. It is combined with V3A on the unit using sharing diodes to provide a 3.3Vdc power supply. It is an Input signal coming from the other PSUP, via backpanel.

The V5A is a +5.4Vdc auxiliary supply (5V after unit combining diodes). It is an Output (backpanel) signal.

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory and Alarms gathering. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres Output signal carryies the Card Presence information. It is a dedicated (backpanel) wire between PSUP1000 and ESCT.

The TEMP_W_1_7 is an Input backpanel command from the associated slots 1 to 7, to set the rotation speed of the FAN module 1# to 100% of its nominal value. It is launched when one of the boards temperature increases above the warning threshold.

4.5 FANS1000

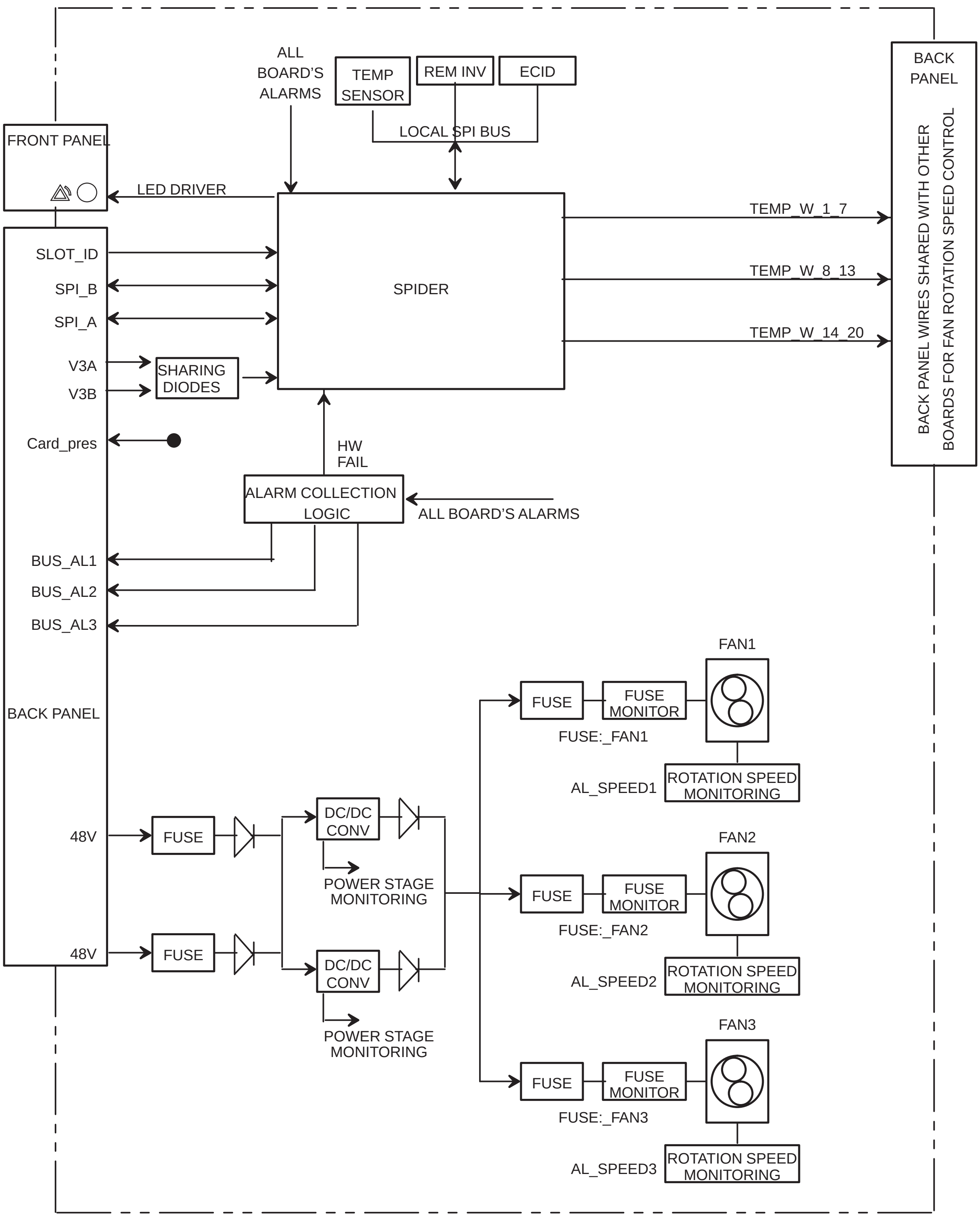


Figure 109. FANS1000 block diagram

Due to the compacity of 1626 LM shelf and the boards density per shelf, fans are necessary to dissipate the heat and to regulate the boards temperature.
The fans are located at the bottom of each shelf (slot 41) of a rack with in addition an air filter just below, as shown on Figure 110.
The FANS are monitored via the SPI bus and some direct wires are sent to the HSKU and the RAIU boards to monitor a possible failure of the cooling system.
The maximum power dissipation per shelf is 640 W.

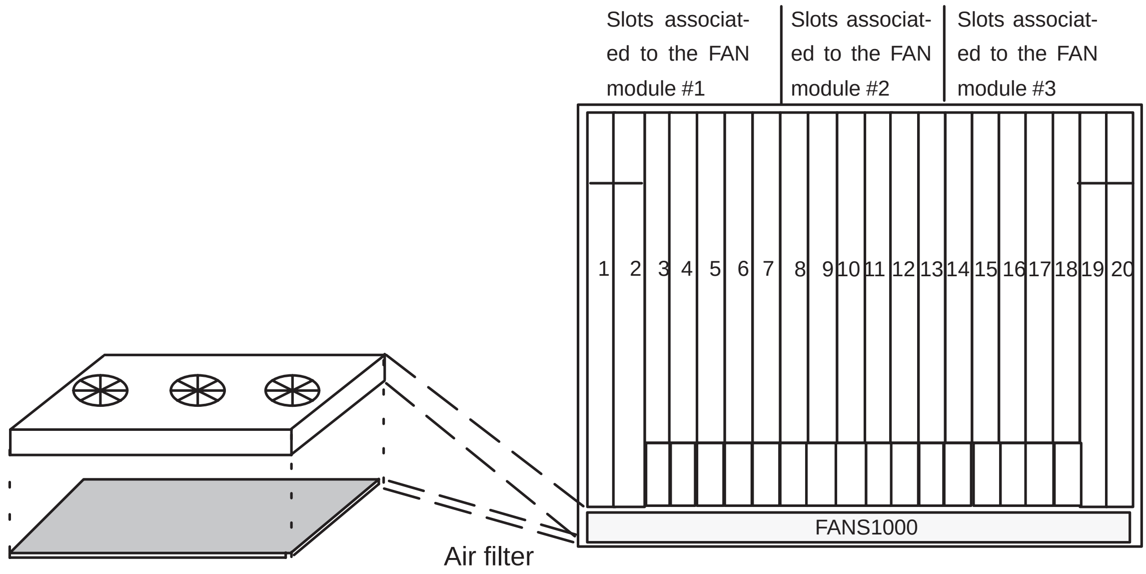


Figure 110. Fan shelf description and Rack partitioning

The main target of the FANS1000 drawer is to avoid overheating and possible board damages.
For each FAN module, some HW parameters are monitored to raise board alarms such as the 48V power supply failure (PS_48V_i_FAIL), the fuse (FUSE_FANj) or the rotation speed (AL_SPEEDj).
They are then collected by the Alarms Logic to raise an HW failure of the FANS1000 unit to the SPIDER and also an individual alarm for each FAN module on a dedicated back panel wire (BUS_AL#i), used by the RAIU or the HSKU to monitor a failure of the cooling system.

The TEMP_W_x_y (where x_y can be 1_7 or 8_13 or 14_20) represents the external control of each FAN module rotation speed, by the boards associated to this module. In fact, the boards of a group share the same back panel wire to control the rotation speed of the corresponding FAN module: if the temperature of one of the boards exceeds a given threshold, the board sends a command to the FAN module to increase its rotation speed.

The **SPIDER** provides the front–end interface to the SPI bus and allows the SPI bus to interface to an internal on board serial bus on which the memories (remote inventory, ECID) are connected, permitting the Shelf Controller to acknowledge data (code identification, serial number, Card type, alarms..) from the board.

It drives the Green/Red led of the board ( ).

POWER SUPPLY. Two +48V power supplies are generated by DC/DC converters from 2 external batteries, providing supply redundancy.
The 2 batteries from back–panel can vary from 36V to 72V. On the board the two 48V voltages (48V_A, 48V_B) are coupled together by a diode and the battery with the maximum voltage is selected.
The card includes fuses in the 48V supply.
The 48V voltages are then filtered on the Power Supply part of the board and then forwarded to DC/DC converters to provide 2 regulated voltages 48V_1 and 48V_2. Two voltages are generated for security.
The output of each DC/DC converter is connected to a comparator on the Monitoring Block which generates an alarm (sent to the SPIDER) if the voltage is under 43V.
All components on the card are powered from the 48V supply, with the exception of the SPIDER device which is supplied via the external backplane 3.3V supply.

FANS1000 buses and dedicated links

For board management

The SPI bus is a duplicated I/O backpanel bus, used for Remote Inventory and Alarms gathering. The SPI_A is the working bus; the SPI_B is the protecting bus.

The Slot_ID is an Input signal used to read the slot identifier data written (short/open circuits) on the backplane.

The Card_Pres Output signal carryies the Card Presence information. It is a dedicated (backpanel) wire between PSUP1000 and ESCT.

For cooling system management

The BUS_AL1 is an Output backpanel command towards the RAIU and the HSKU to indicate an HW failure of the FAN module #1.

The BUS_AL2 is an Output backpanel command towards the RAIU and the HSKU to indicate an HW failure of the FAN module #2.

The BUS_AL3 is an Output backpanel command towards the RAIU and the HSKU to indicate an HW failure of the FAN module #3.

The TEMP_W_1_7 is an Input backpanel command from the associated slots 1 to 7, to set the rotation speed of the FAN module 1# to 100% of its nominal value. It is launched when one of the boards temperature increases above a pre–defined threshold.

The TEMP_W_8_13 is an Input backpanel command from the associated slots 8 to 13, to set the rotation speed of the FAN module 2# to 100% of its nominal value. It is launched when one of the boards temperature increases above a pre–defined threshold.

The TEMP_W_14_20 is an Input backpanel command from the associated slots 14 to 20, to set the rotation speed of the FAN module 3# to 100% of its nominal value. It is launched when one of the boards temperature increases above a pre–defined threshold.

5 TECHNICAL SPECIFICATIONS

5.1 1626 LM system characteristics

5.1.1 Main system characteristics

General	
Optical bit rate, client side (B&W)	9.9532 Gbps (UNI) – TRBD1x1z and TRBD1x2z using 10.709 Gbps (NNI) – TRBD1011, TRBD1111 and TRBD1121 using (future release) 10.3125 Gbps (UNI, 10GBE LAN) – TRBD1131 only 2.488 Gbps (UNI) – TRBC1111 using 2.666 Gbps (NNI) – TRBC1111 using (future release)
Optical bit rate, WDM side	10.709 Gbps for TRBDwx1z and TRBDwx2z 11.09 Gbps for TRBD1131
Type of optical fiber	G.652, G.655, G.652 for tight links
Central frequencies and wavelengths	see Table 12. on page 129
Application types	Line Terminal (LT), Line Repeater (LR), Regenerative Back–to–Back Terminal (BT), OADM Repeater (OR)
Interfaces types	Electrical interfaces: 2Mbps G.703 (user channels), RS–232 at 38.4 Kbps (CT interface), 10 Gbps Ethernet 10Base–T or 10Base–2 (NMS interface) Optical interfaces: all the client and WDM interfaces above listed
System dimensions	
Maximum number of racks in Line Terminal configuration	3 (up to two racks can be managed in rel. 2.0)
Maximum number of racks in OADM/ Back–to–Back configuration	4 (up to two racks can be managed in rel. 2.0)
Add–Drop features	
Connectivity	0–100% add–drop capability by means of the Band–OADM application (BMDX1100)
Protections	
Network protections	Optical SNCP, realized by means of an external OCP equipment (future rel.)
Equipment optical protections	1+1 TRBD and TRBC, realized via an external OCP equipment
Powering protections	1+1 Power Supply Card

Management interfaces

Functions provided	–	Q3 interf with PC (CT/Remote CT), 1353SH and 1354RM NMS (on terminal)
	–	Station alarms
	–	Equipment Alarm status (indicated by the front cover LEDs)
	–	Visual indications for card fail.
Management interfaces supported:	–	Q3 to connect a Local or Remote Equipment Craft Terminal (RS 232 interface at 38.4Kbps)
	–	Q3 to connect the OS 1353SH (10 Mbps 10Base–2 or 10Base–T Ethernet Interface)

Local interface:	Craft Interface (PC)	RS232 SUB–D 9pin, PC compatible at 38.4 Kbps
Remote interface:	Craft Interface (PC)	RS232 SUB–D 9pin, PC compatible at 38.4 Kbps. It handles up to 32 NEs via DCC
Remote interface:	Transmission Management Network (TMN) interface	ITU–T G.773 10 base–2 and 10 base–T
Protocol Stack/Information Model messages		Q3

Operation processes (management interfaces functions)

Configuration and provisioning	Equipment, Units, Add–Drop, Alarms status, Maintenance memory for all the equipment events
Software download	It is made locally as well as remotely on non volatile memories without traffic interruption
Performance monitoring	Based on B1 and J0 n.i.m. and Treshold Crossing Alarm based on B1 errors count, client/B&W side (SDH/SONET), according to G.806, G.8201, G.709. Based on FEC corrected/uncorrected errors, WDM side.
Remote Inventory	At rack, subrack and board level
Unit and equipment acknowledgement	Through Remote Inventory: Company id, Unit type, Unit part number, Software part number, CLEI code, Manufacturing Plant, Date Identifier, Date of construction... For details, refer to the operator's handbook
Security	Password, operator profile, back up for programs and data

Housekeeping (HSKU)	
Number of housekeeping accesses	8 inputs and 8 outputs
Connector	SUB–D 25 pins
Output HSKU signals	By electronic relay contacts connected to the common out
– Max. guaranteed current through IN relay with closed condition	100 mA
– Voltage between OUTn and common OUT with closed condition	<2.5 V
– Resistance of the closed relay with closed condition	<300 mOhms
– Voltage between OUT and common with open condition	<72 V
Input HSKU signals	By opto–couplers connected to the common GND (GNDP)
– maximum forward current	30 mA
– maximum voltage applied between INn and GNDP	3 V (without resistor)

N.B. If the user wants to connect –48V power supply, he has to put a resistor of a value higher than 1500 Ohms, 1.5 W to have a current equal to 30mA.

Optical Supervisory Channel (OSC) characteristics. See para. 5.3.2.6 on page 228.

Clock characteristics

Transponders support 3R regeneration. External clock is not required

Applicable standards	
ITU–T G.709	Interfaces for the Optical Transport Network (OTN)
ITU–T G.798	Characteristics of optical transport network hierarchy equipment functional blocks
ITU–T G.691	Optical interfaces for single channel STM–64, STM–256 systems and other SDH systems with optical amplifiers
G. 693	Optical interfaces for intra–office systems
ITU–T G.692	Optical interfaces for multichannel systems with optical amplifiers
ITU–T G.872	Architecture of optical transport networks
ITU–T G.957	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy
ITU–T G.959.1	Optical transport network physical layer interfaces
G.7710	Common equipment management function requirements
G874.1	Optical Transport Network (OTN) protocol–neutral management information model for the network element view
ITU–T G.664	Optical safety procedures and requirements for optical transport systems
ITU–T G.825	The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)
IEEE 802.3	Ethernet standard
IEC60825–1 and IEC60825–2	Optical safety

The nominal frequencies allocation plan in Extended C–Band is shown in Table 12. on page 129.

The loading plan is shown in para. 3.1.2.1 on page 135.

5.2 Safety requirements and mechanism

5.2.1 Electrical safety

The electrical and mechanical safety is compliant with the requirements of the IEC 60 950 Standard.

Electrical safety	
Safety status of the connections with other equipment	TNV (Telecommunication Network Voltage) for Remote alarms, Housekeeping, Rack lamps (RM) and tributary connections if K20 protected. SELV (Safety Extra Low Voltage) for all the other.

5.2.1.1 Labelling

The labels reproduced in para. 3.2.3.1 on page 23 are affixed during factory settings.

5.2.1.2 Safety instructions

The safety instructions for proper assembly, maintenance and safe use including clear warning concerning precautions to avoid possible exposure to hazardous voltages, are reported in para. 3.2 on page 21 and more specifically in para. 3.2.3.2 on page 23.

5.2.2 Optical safety

5.2.2.1 Equipment Hazard Level classification and standards

The classification refers to the **IEC 60825 Standard (with amendments 1 & 2)**.
This recommendation defines 4 HAZARD LEVELs for optical fiber applications in third window (1500 – 1800 nm) :

- **HAZARD LEVEL 1, for optical power below +10mW (10dBm)**
- **HAZARD LEVEL 1M, for optical power in [10mW; 136mW] (10dBm to 21,3dBm)**
- **HAZARD LEVEL 3B, for optical power in [136mW; 500mW] (21,3dBm to 27dBm)**
- **HAZARD LEVEL 4, for optical power higher than 500mW (>27dBm).**

G.664 standard defines the optical safety mechanisms :
- Automatic Laser Shutdown (ALS): Procedure to automatically shutdown the output power of laser transmitters and to avoid exposure to hazardous levels
- Automatic Power ShutDown (APSD) : Procedure to automatically shutdown the output power of optical amplifiers to avoid exposure to hazardous levels.

This recommandation defines also the following areas for laser application installation
- **Unrestricted Area** (location where access to the transmission equipment is accessible to the public).
  APSD mandatory if accessible optical power could exceed hazard level 1 AEL (Accessible Emission Limit)
- **Restricted Area** (location that is normally inaccessible by the general public but that is accessible to personnel that may not have laser safety training).
  APSD mandatory if accessible optical power could exceed hazard level 1M AEL (Accessible Emission Limit) or if optical power can exceed class1 from connector
- **Controlled Area** (location that is inaccessible except to authorized personel with appropriate laser safety trainig).
  APSD mandatory if accessible optical power could exceed hazard level 1M from connector and hazard level 3B AEL (Accessible Emission Limit) from a failed fiber.

In any case of failure, the overall FIT rate of all the mechanisms inside the system that are involved in the APSD procedure which is triggered by this failure, shall not exceed **500 FITs**.
For example, in case of external failure between two line repeaters, two Shut Down mechanisms are involved, one per site. The mechanisms involved in each both sites are exactly the same so that each mechanism must not exceed 250 FITs.

In **normal operating conditions** (no failure), the system matches **HAZARD LEVEL 1M** criteria.
During the **restart mechanism**, the system matches **HAZARD LEVEL 1M** criteria.

So according to IEC 60825 recommandation, the 1626 LM equipment is classified as

HAZARD LEVEL 1M

The OSC alone is classified as

HAZARD LEVEL 1

The following figures give the AELs of class 1 and class 1M. In other words, it gives the maximum power that can be reached to remain in Class 1 or in Class 1M ; the integration duration is 100 sec.

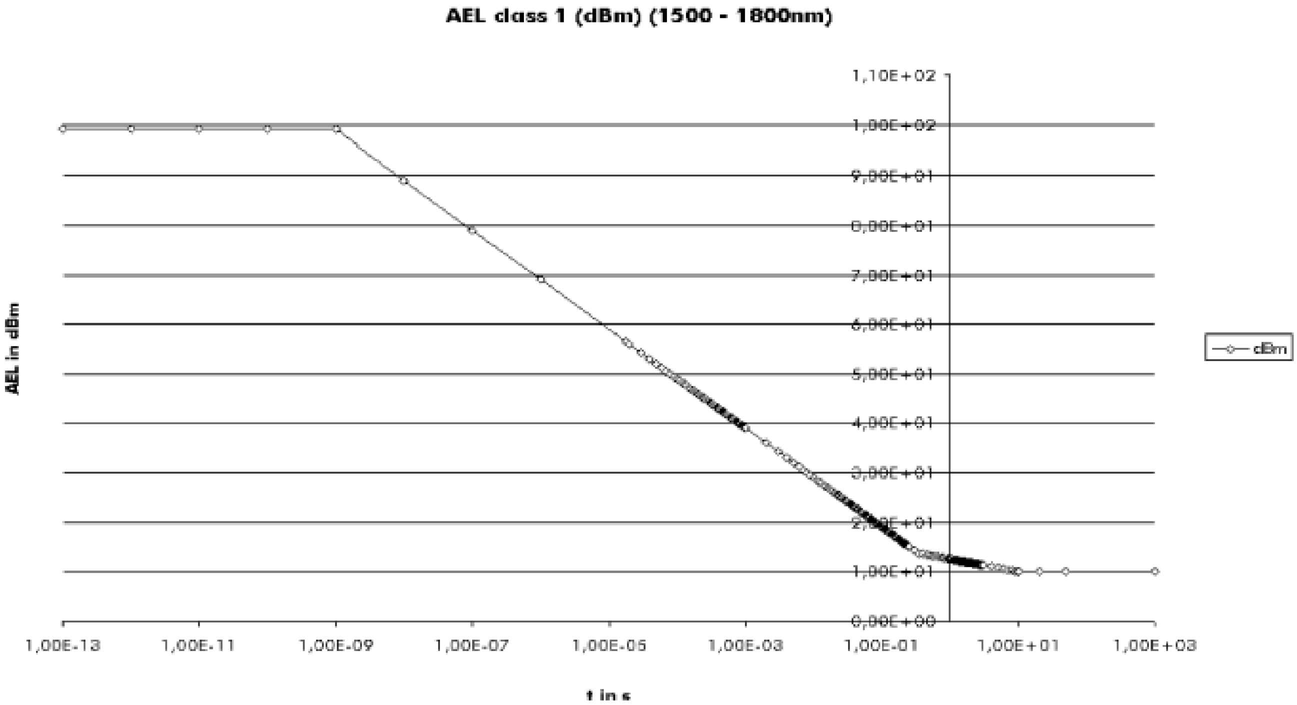


Figure 111. AEL for Class 1 between 1500 nm and 1800 nm

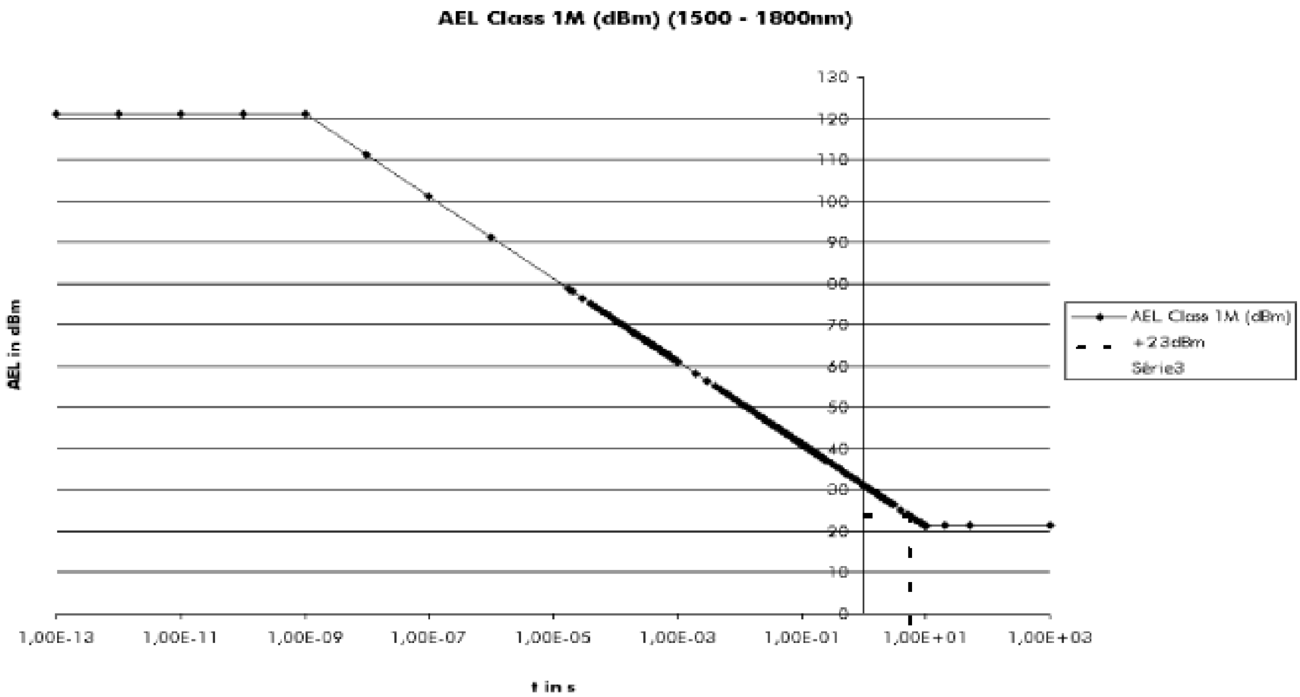


Figure 112. AEL for Class 1M between 1500 nm and 1800 nm

Table 19. AEL at 980 and 1480 nm for Hazard Levels 1 and 1M

Wavelength	Hazard Level1 Accessible Emission Limit	Hazard Level1M Accessible Emission Limit
980 nm	1.42 mW or 1.52 dBm	2.66 mW or 4.25 dBm
1480 nm	10 mW or 10 dBm	115 mW or 20.6 dBm

5.2.2.2 Labelling

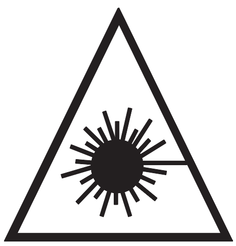
The labelling of the optical sources is compliant with the requirements of the IEC 60825 Standard.

The labels reported below are put during factory settings. The labels are affixed on all front covers that protect optical connectors located on the front side plate of all the units involved in optical transmission.

In the following, some examples of labelling are reported.

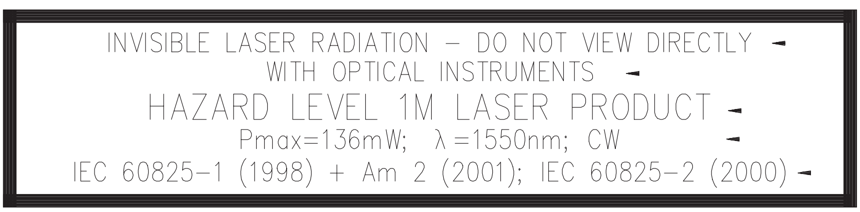
The optical interfaces which have **HAZARD LEVEL 1**, carry the following explanatory label

The following label indicates the presence of a LASER beam. If the laser is a Hazard Level 1 or 1M product, this label is not compulsory.



Example of EXPLANATORY label.

The optical interfaces which have **HAZARD LEVEL 1M** according to IEC 60825–1 (2001), IEC 60825–2 (2000) and ITU–T Rec. G.664 standards and operate at 3rd window, carry the following explanatory label



5.2.2.3 Aperture and fiber connectors

The locations of apertures and fibre connectors are reported on topographical drawings of units front view and access cards front view in paragraph 2.4 on page 105.

5.2.2.4 Engineering design features

In normal operating conditions, unless intentional manumission, the laser radiation is never accessible. The laser beam is launched in optical fibre through an appropriate connector that totally shuts up the laser radiation. Moreover a plastic cover is fitted upon optical connectors by means of screws.

5.2.2.5 Safety instructions

The safety instructions for proper assembly, maintenance and safe use including clear warning concerning precautions to avoid possible exposure to hazardous laser radiation, are reported on para. 3.2 on page 21 and more specifically in para. 3.2.4 on page 24 thru 25.

5.2.2.6 APSD procedure

The APSD complies with IEC 60825 1 and 2 and ITU–T G.664 reccomendations.

5.2.2.6.1 Generic APSD rules

The purpose of the following rules is to comply with the requirements of eye safety and to protect equipments against overshooting.

⚠ The proposed implementation complies with safety standards subject to the Terminal if housed in a Restricted Area.

5.2.2.6.2 APSD example: line failure between two line repeaters

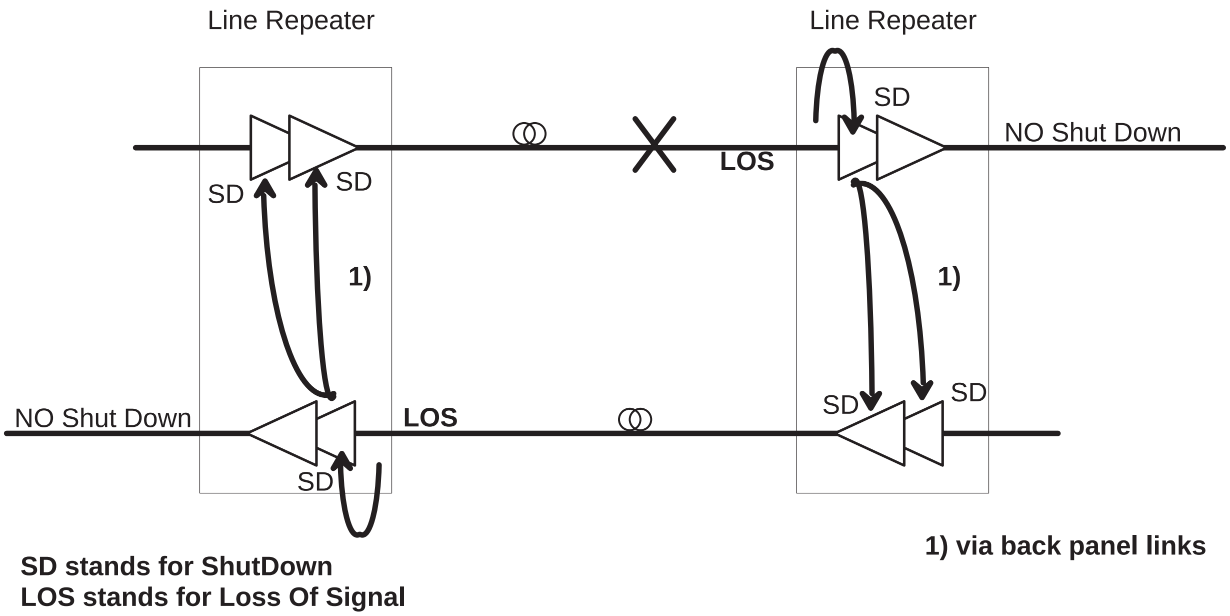


Figure 113. Example of line failure between two Line Repeaters

Let us consider the right NE (the same actions occur in the left NE as soon as it detects the LOS consecutive to the APSD procedure in the right NE)

a) The top right amplifier detects a LOS

b) It shuts down its first stage (overshoots protection)

c) The previous amplifier exists but is located in an other NE so the top right amplifier has to shut down the other amplifier of the right NE : the top right amplifier writes a SD command on its APSD back panel link.

d) As software knows how amplifiers are connected, it has configured (during installation phase) the down right amplifier to read the APSD back panel link written by the top right amplifier. As a consequence, the down right amplifier receives the SD command sent by the top right amplifier.

e) The down right amplifier shuts down.

f) The low amplifier of the left NE detects a LOS, the same procedure as the one already described for the right NE applies.

5.3 Boards interfaces characteristics

5.3.1 Tributaries optical characteristics

5.3.1.1 TRiButary Direct transponders TRBD1xyz characteristics

Optical characteristics of the Client/B&W interface of the TRBD1x1z units			
Common specification of the B&W optical interfaces			
B&W interface bit rate (IN/OUT)	9.9532 Gbps ± 20 ppm – UNI 10.709 Gbps ± 20 ppm – NNI 10.3125 Gbps ± 100 ppm – UNI (10 GBE LAN)		
B&W signals (UNI)	10 GB Ethernet LAN for TRBD1131 STM–64 (SDH), OC–192 (SONET), 10 GB Ethernet WAN, other 9.95320 Gbps signals (e.g. PRBS) for all the other TRBDs		
Wavelength range	1290 ÷ 1330 nm for TRBD1110, TRBD1011, TRBD1111 1530 ÷ 1568 nm for TRBD1121 1260 ÷ 1355 nm for TRBD1131		
User interface type	I–64.1; VSR 2000 for TRBD1110, TRBD1011, TRBD1111 S–64.2b for TRBD1121 10GBASE–LR for TRBD1131		
Connector type	MU/SPC		
B&W interf. – Transmitter specification	I–64.1 (TRBD1110, TRBD1011, TRBD1111)	S–64.2b (TRBD1121)	10GBASE–LR (TRBD1131)
Fiber type		Single–mode (SMF)	
Mean output power	–6 dBm ÷ –1 dBm	–1 dBm ÷ +2 dBm	–3 dBm ÷ 0.5 dBm
Minimum extintion ratio	min : 6 dB	min : 8.2 dB	min : 3.5 dB
Maximum –20dBm width	1 nm	–	
Side mode suppression ratio			30 dB
B&W interface – Receiver specification	I–64.1	S–64.2b	10GBASE–LR
Fiber type		Single–mode (SMF)	
Sensitivity @ BER = 10^{-12}	min : –11 dBm	min : –14 dBm	
Sensitivity under stressed conditions			min : –11 dBm
Overload @ BER = 10^{-12}	min : –1 dBm	min : –1 dBm	tbd
Dispersion accomodation	max : 6.6 ps/nm	max : 800 ps/nm	
Receiver reflectance	max : – 27 dB	max : – 27 dB	max : – 12 dB
Supported optical path penalty	max : 1 dB	max : 2 dB	

Optical characteristics of the WDM interface of the TRBD1x1z units

WDM interface – Common specification	
Wavelength specification	ITU–T G.692, 50 GHz channel spacing
Wavelength tunability	over 2 frequencies for TRBD1011 over the whole extended C–band for TRBD1111, TRBD1121, TRBD1131 over a 8–channel sub–band for TRBD1111, TRBD1121
Wavelength range	1530,33 ÷ 1568,36 nm
Frequency range	195,900 ÷ 191,150 THz
WDM interface bit rate (IN/OUT)	11.096 Gbps ± 20 ppm for TRBD1131 10.709225 Gbps ± 20 ppm for all the other TRBDs
Fiber type	Single–mode (SMF)
Connector type	MU/SPC

WDM interface – Transmitter specification	**TRBD1011**	**TRBD1111, TRBD1110, TRBD1121, TRBD1131**
Output power (VOA at minimum attenuation)	–3 ÷ –2.5 dBm	1 ÷ 1.2 dBm
Output power range	21 dB	25 dB
Output power step, over the above specified range	0.5 dB	0.5 dB
Output power setting accuracy	–0.25dB ÷ +0.25 dB	–0.25dB ÷ +0.25 dB
Output power stability over life and temperature	–0.5dB ÷ +0.5dB	–0.5dB ÷ +0.5dB
Output power when the frequency is not locked or the board is not in service	max –42 dBm	max –42 dBm

WDM interface – Receiver specification	**TRBD1011**	**TRBD1111, TRBD1110, TRBD1121, TRBD1131**
Input optical power	–20.2 ÷ 8 dBm	–21.2 ÷ 2 dBm

5.3.1.2 TRiButary Concentrator (TRBC1111) characteristics (future release)

Optical characteristics of the Client/B&W interfaces of the TRBC1111 unit	
Common specification of the B&W optical interfaces	
B&W interface bit rate (IN/OUT)	2.488 Gbps ± 20 ppm – UNI 2.666 Gbps ± 20 ppm – NNI (OTU–1)
B&W signals (UNI)	STM–16 (SDH) OC–48 (SONET)
User interface type	I–16.1 S–16.1
Wavelength range	1266 ÷ 1360 nm (I–16.1) 1260 ÷ 1360 nm (S–16.1)
Connector type	LC/SPC
B&W interfaces – Transmitter specification	**S–16.1**
Fiber type	Single–mode (SMF)
Mean output power	min : –5 dBm; max : 0 dBm
Minimum extintion ratio	8.2 dB
Maximum –20 dBm width	min : 1 nm
B&W interfaces – Receiver specification	**S–16.1**
Fiber type	Single–mode (SMF)
Sensitivity @ BER = 10^{-10}	min : –18 dBm
Overload @ BER = 10^{-10}	min : 0 dBm
Dispersion accomodation	NA
Receiver reflectance	max : –27 dB
Supported optical path penalty	max : 1 dB

Optical characteristics of the WDM interface of the TRBC1111 unit

WDM interface – Common specification	
Wavelength specification	ITU–T G.692, 50 GHz channel spacing
Wavelength tunability	over the whole C–Band
Wavelength range	1530,33 ÷ 1561,82 nm
Frequency range	195,900 ÷ 191,950 THz
WDM interface bit rate (IN/OUT)	10.709225 Gbps ± 20 ppm
Fiber type	Single–mode (SMF)
Connector type	MU/SPC
WDM interface – Transmitter specification	
Output power (VOA at minimum attenuation)	1 ÷ 1.2 dBm
Output power range	25 dB
Output power step, over the above specified range	0.5 dB
Output power drift accurancy	min: –0.25 dB; max : +0.25 dB
Output power stability over life and temperature	min:–0.5dB; max:+0.5dB
Output power when the frequency is not locked or the board is not in service	max –42 dBm
WDM interface – Receiver specification	
Input optical power	–22 ÷ 2 dBm

5.3.2 Multiplexers / demultiplexers optical characteristics

5.3.2.1 8:1 and 1:8 Channel Mux / DemultipleXer (CMDX1010) optical characteristics

CMDX1010 optical interfaces specification					
CMDX Common specification					Comments
Nominal Channel Centre frequencies	See wavelength allocation table (Table 12. page 129)				
Fiber type	Single–mode (SMF)				
Connector type	MU/SPC				
CMX parameters (multiplexing side)	minimum	typical	maximum	units	Comments
Channel Passband	44		44	GHz	Centered on the frequencies specified in Table 12.
Insertion loss	5.0	6.8	8.2	dB	Across all channel centres
CMX input power	–27		15	dBm	At one input
CMX output power	–32		19	dBm	At combined output

CDX parameters (demultiplexing side)	minimum	typical	maximum	units	Comments
Channel Passband	20		20	GHz	Centered on the frequencies specified in Table 12.
Insertion loss	5.0	6.4	7.3	dB	Across all channel centres
CDX input power	–5		15	dBm	

5.3.2.2 12:1 and 1:12 Band Multiplexer/ DemultipleXer (BMDX1000) optical characteristics

BMDX1000 optical interfaces specification					
BMDX1000 Common specification					Comments
Fiber type	Single–mode (SMF)				
Connector type	MU/SPC				
BMDX1000 parameters	minimum	typical	maximum	units	Comments
Nominal centre frequencies (υ nom)	192.3125; 191.7125; 192.1125; 192.5125; 192.9125; 193.3125; 193.7125; 194.1125; 194.5125; 194.9125; 195.3125; 195.7125;			THz	See also Table 16. on page 177
Clear Passband	–212.5		212.5	GHz	With respect to the band nominal centre frequency

5.3.2.3 12:1 and 1:12 Band Multiplexer/DemultipleXer for Band OADM (BMDX1100) optical characteristics

BMDX1100 optical interfaces specification				
BMDX1100 Common specification				Comments
Fiber type	Single–mode (SMF)			
Connector type	MU/SPC			
BMDX1100 parameters	minimum	maximum	units	Comments
Nominal centre frequencies (υ nom)	191.3; 191.7; 192.1; 192.5; 192.9; 193.3; 193.7; 194.1; 194.5; 194.9; 195.3; 195.7		THz	See also Table 17. on page 181
Clear Passband	–160	+160	GHz	With respect to the band nominal centre frequency (υ nom)

5.3.2.4 Automatic Laser Control (ALCT1010) optical characteristics

ALCT1010 optical interfaces specification	
Fiber type	Single–mode (SMF)
Connector type	MU/SPC
Maximum optical output power	11 dBm (as min. value)
Minimum optical output power	–14 dBm (as max. value)

Table 20. ALCT1010 wavelengths list

BAND #	ALCT frequency
2	195.35 THz
3	194.95 THz
4	194.55 THz
5	194.15 THz
6	193.75 THz
7	193.35 THz
8	192.95 THz
9	192.55 THz
10	192.15 THz
11	191.75 THz
12	191.35 THz

5.3.2.5 LOFA11y0 optical characteristics

LOFA1110, LOFA1120 optical interfaces specification			
LOFA Common specification			
Fiber type	Single–mode (SMF)		
Connector type	MU/SPC		
LOFA11y0 optical ports	minimum	maximum	units
first stage input power	–35	+2	dBm
first stage output power	0	+19	dBm
second stage input power	–15	+19	dBm
second stage output power	+6	+23	dBm
OSC output (extraction) level	–50	–16	dBm
OSC input (extraction) level	–1	+1	dBm
first stage input power monitoring	–51	–14	dBm
first stage output power monitoring	–23	–4	dBm
second stage output power monitoring	–17	0	dBm
Wavelength range (96 chs. aggregate signal)	1530.33	1568.57	nm
Wavelength range (OSC port)	1500	1520	nm
Tuning step	0.5		dB
Absolute tuning accuracy	–0.45	+0.45	dB
Relative tuning accuracy	–0.3	+0.3	dB
Maximum EOL output power without EMPM		+20	dBm

5.3.2.6 Optical Supervisory Channel Unit (OSCU1010) optical characteristics

OSCU1010 optical characteristics	
Common specification	
Nominal bit rate	4 864 kbps (default configuration) => 2Mb for LAPD (OSC) + 2 Mb for user channels (UDC)
Fiber type	Single–mode (SMF)
Connector type	MU/SPC
Wavelength	1510 ± 5 nm

5.4 Alarm characteristics

Units Alarms:

Each port card or access card of the equipment is provided with a bicolor (green/red) or three–color (green/ yellow/red) LED ( ) on the front coverplate.

This LED indicates:

– when red, internal failure
– when green, in service unit
– when yellow, board in firmware download state (only for TRBD, CMDX and BMDX).

Centralized Equipment Alarms:

All the alarms detected on the units are collected by the **ESCT1000 unit** which will deliver centralized optical indications (by means of LEDs on its front coverplate). Specifically:

- Red LED **“URG“**: detection of an **URGENT (MAJOR OR CRITICAL)** alarm
- Red LED **”NUR”**: detection of a **NOT URGENT (MINOR)** alarm
- Yellow LED **”ATD”**: alarm condition **ATTENDED**

Refer to para. 2.4 on page 105, where the front view of each unit and the LED locations are illustrated.

N.B. On the Craft Terminal (C.T.) and on the Operation System (O.S). application the URGENT (URG), NOT URGENT (NURG) and WARNING alarms are named in a different way; the relation between this two terminology is explained in Table 21. on page 229.

Table 21. Relation between Alarm severity terminology displayed on C.T./O.S. and alarm severity terminology used for the ESCT leds and ETSI market racks (TRU).

Alarm severity terminology on C.T. and O.S.	Alarm severity terminology used for ESCT leds and for TRU in the rack
CRITICAL or MAJOR	URG
MINOR	NURG
ATTENDED	ATTD

Rack Alarms:

Some equipment alarms are carried to a connector and used to light–up alarm rack–lamps. Rack alarms are physically available on the RAIU board connectors.

TRU Front Panel LEDs (ETSI)		
Marking	Description	Led color
URG	Urgent alarm input from one of the shelves in the rack ON if the RAIU raises the Critical or the Major alarm	RED
NURG	Non urgent alarm input from one of the shelves in the rack ON if the RAIU raises the Minor alarm.	RED
ATTD	Attended: acknowledged URG/NURG alarms after an alarm cut off by the operator (ACO push button on the ESCT front panel).	YELLOW
SIG PRES	Signal presence (power ON)	GREEN

The TRU has four front panel leds: Urgent, Non Urgent, Attended, Signal Presence. Those leds are managed by the RAIU boards of a rack, except for the last one which indicates that the power is ON. The TRU has four DB25 connectors so that the RAIU boards of a rack can be either linked together or directly connected to the TRU.
In NEs composed of more than one rack, the TRU of the master rack shows both the HW alarms of the rack and the summary of the NE alarms. The TRU LEDs in secondary racks only show the HW failures of the rack (from the FANS or the power supplies).

HouseKeeping Alarms/Commands:

A set of housekeeping contacts are available, located on the 25–pole connector of the housekeeping board.

Alarm Attending:

The detected units alarm condition can be stored through the **ACO** (Alarms Cut Off) push–button on the ESCT unit (Attended)**.**
This operation will turn OFF the general red LED **"URG"** and will light up the **"ATD"** yellow LED on the ESCT unit (Attended); the attended command is also sent to the rack lamps (if present) through the RAIU board.

Trouble–shooting:

This equipment has been designed to dialog with a Personal Computer (PC) for service, activation and trouble–shooting purpose.
Trouble–shooting procedure for the equipment and details of the alarms for each card and relevant indications are described in the **Operator's Handbook**.

Connection with the PC is achieved through the 9–pole connector (F interface) on the ESCT board.

The unit can be connected to an Operation System associated to the Transmission Management Network in order to execute operations similar to those carried out by the PC.

Characteristics of the cited rack alarms and Housekeeping contacts interface (EM type) are inserted in Chapter 5.1 on page 209.

5.5 Power supply characteristics

Input Voltage range (from station batteries)	– 40,5 V < – 48 V < – 57,0 V – 57,0 V < – 60 V < – 72,0 V
Power supply output voltages towards units	48/60V filtered + 3.7 V (by DC/DC conv) + 5.4 V (by DC/DC conv)

The PSUP takes a 48V/60V battery supply and filters it before making it available on the backplane. It then uses the redundant (filtered) 48V supplies to power the on board 3.7V and 5.4V supplies. The unit also uses the 3.7V supply (either from the on board converter, or if failed from the backplane) to power its SPIder. The maximum current drawn from these power rails shall not exceed the following requirement

48/60 V battery rail	TBD
48/60 V filtered rail	TBD
3.7 V rail	TBD
Power supply interface	according to ETS EN 300132–2

5.5.1 Maximum power consumption of the boards and units

Unit	Maximum power consumption [W]
TRBD1110, TRBD1011, TRBD1111, TRBD1131	35
TRBD1121	38
TRBC1111	39
BMDXwxyz	10
CMDX1010	15
ALCT1010	15
LOFA11y0	26
ESCT1000	15
OSCU1010	15
RAIU1000	2
HSKU1000	2
PSUP1000	10
FANS1000	60 (when the three FAN modules are at high rotation speed)

5.6 Mechanical characteristics

Rack mechanical compatibility	ETSI ETS/E3, Optinex compatible
1626 LM subrack size	500 mm W x 280 mm D x 466 mm H
Board size	there are three types of board: – full height, 25 mm width (BMDX, TRBD, TRBC) – medium height, 20 mm width (CMDX, ESCT) – small height, 20 mm width (PSUP, HSKU, RAIU)
Cooling	Fans located at the bottom of the shelf
Rack cabling	Vertical between rack and subrack front access
Electrical Connectors	SUB–D 3–pole connector : power supply SUB–D 25–pole connector : housekeeping interface SUB–D 9–pole connector : F and RAIU interfaces BNC : Q interface for 10Base2 NMS connection RJ45 : 2Mbps user interface on TRBD/TRBC (future release) RJ11 : RAIU interface
Back–to–back installation	Yes
Boards dimension	
TRBDwxyz	353.6mm height x 212.5mm depth x 25mm width
TRBC1111	353.6mm height x 212.5mm depth x 25mm width
CMDX1010	265mm height x 212.5mm depth x 20mm width
BMDX1x00	353.6mm height x 212.5mm depth x 25mm width
ALCT1010	265mm height x 212.5mm depth x 20mm width
LOFA11y0	265mm height x 212.5mm depth x 20mm width
ESCT1000	265mm height x 212.5mm depth x 20mm width
OSCU1010	265mm height x 212.5mm depth x 20mm width
RAIU1000	73mm height x 212.5mm depth x 20mm width
HSKU1000	73mm height x 212.5mm depth x 20mm width
PSUP1000	73mm height x 212.5mm depth x 20mm width

5.7 Environmental characteristics

The 1626 LM is designed to be compliant to ETSI standards.

The technical data of this chapter are referred to ITU–T Recommendations and ETSI Standards.

5.7.1 Climatic for operating conditions

The Equipment meets the requirements of ETSI Stand. with use of fans housed in an external subrack. The functionality of the 1626 LM Equipment, Vs. Temperature, is in compliance with :

ETS 300 019–1–3 :1992 , class 3.2.

Class 3.2	:	**Partly temperature–controlled locations.** (see climatogram on Figure 114. on page 234)

5.7.1.1 Class 3.2: partly Temperature controlled locations

This applies to locations:

– where installed equipment may be exposed to solar radiation and heat radiation. They may also be exposed to movements of the surrounding air due to draughts in buildings, e.g. through open windows. They may be subjected to condensed water and to water from sources other than rain and icing. They are not subjected to precipitation;

– where mould growth or attacks by animals, except termites, may occur;

– with normal levels of contaminants experienced in urban areas with industrial activities scattered over the whole area and/or with heavy traffic;

– In close proximity to sources of sand or dust;

– with vibration of low significance, e.g. for products fastened to light supporting structures subjected to negligible vibrations.

The conditions of this class may be found in :

– entrances and staircases of buildings;

– garages;

– cellars;

– certain workshops;

– buildings in factories and industrial process plants;

– unattended equipment stations;

– certain telecommunication buildings;

– ordinary storage rooms for frost resistant products and farm buildings, ect.

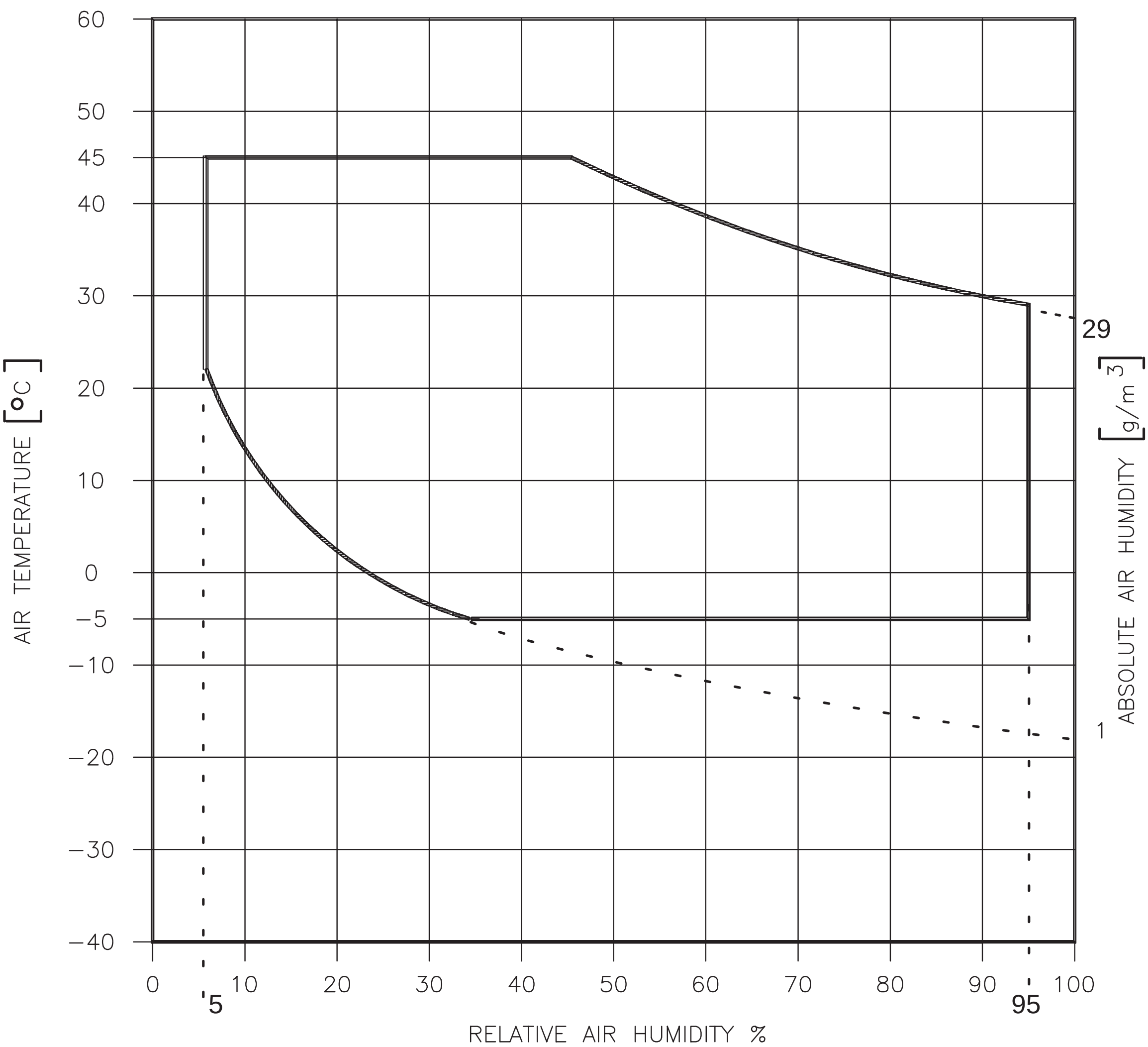


Figure 114. Climatogram for Class 3.2 : Partly temperature controlled locations

The equipment operates within its specified performance limits over the range specified in the climatogram for this environmental class (Figure 114. on page 234).

The equipment thus also operates within its specified performance limits over the temperature and humidity range. Thus an increase in the specified upper temperature limit to +50 °C from +45 °C as specified in EN 300 019–1–3 for Class 3.2.

The applicable extreme external operating conditions are summarised in Table 22. A description of the applicable operating conditions for both the **ETSI requirements** are described below.

Table 22. Environmental Operating Conditions [1]

Parameter	Operational Limits
Low Air Temperature	–5 °C [2]
High Air Temperature	+50 °C [2]
Low Relative Humidity	5% RH
High Relative Humidity	95% RH
Rate of Change of Temperature	0.5 °C/min.
Air Temperature Rise Over Unit Operational max [3]	TBD

[1] Temperatures specified are ambient temperatures external to the equipment, air temperature rises across the subracks within the rackmay result in component surface temperatures being 20 °C above the external air temperature.
[2] Temperature range extended to +50°C to cover the requirements of EN 300 019–1–3 Class 3.2.

5.7.2 Storage

The units are un–powered and packed in a “ready to ship“ condition prior to being subjected to the following storage conditions. The packaging procedures and materials used have to be representative of those used for the final delivered product. The delivered product is: equipped racks, equipped subracks and individual units, unit design is compatible with all of these.

The 1626 LM equipment meets the following requirements Vs. Storage :

ETS 300 019–1–1 : 1992, class 1.2

Class 1.2 : weather protected, not temper. controlled storage location.

This class applies to weather protected storage having neither temperature nor humidity control. The location may have openings directly to the open air, i.e., it may be only partly weatherproofed. The climatogram is shown on Figure 115. on page 237.

This class applies to storage locations :

- where equipment may be exposed to solar radiation and temporarily to heat radiation: They may also be exposed to movements of the surrounding air due to draughts, e.g. through doors, windows or other openings. They may be subjected to condensed water, dripping water and to icing. They may also be subjected to limited wind–driven precipitation including snow;
- where mould growth or attacks by animals, except termites, may occur;
- with normal levels of contaminants experienced in urban areas with industrial activities scattered over the whole area, ad/or with heavy traffic;
- in areas with sources of sand or dust, including urban areas;
- with vibration of low significance and insignificant shock.

The conditions of this class may occur in :

- unattended buildings ;
- some entrances of buildings ;
- some garages and shacks.

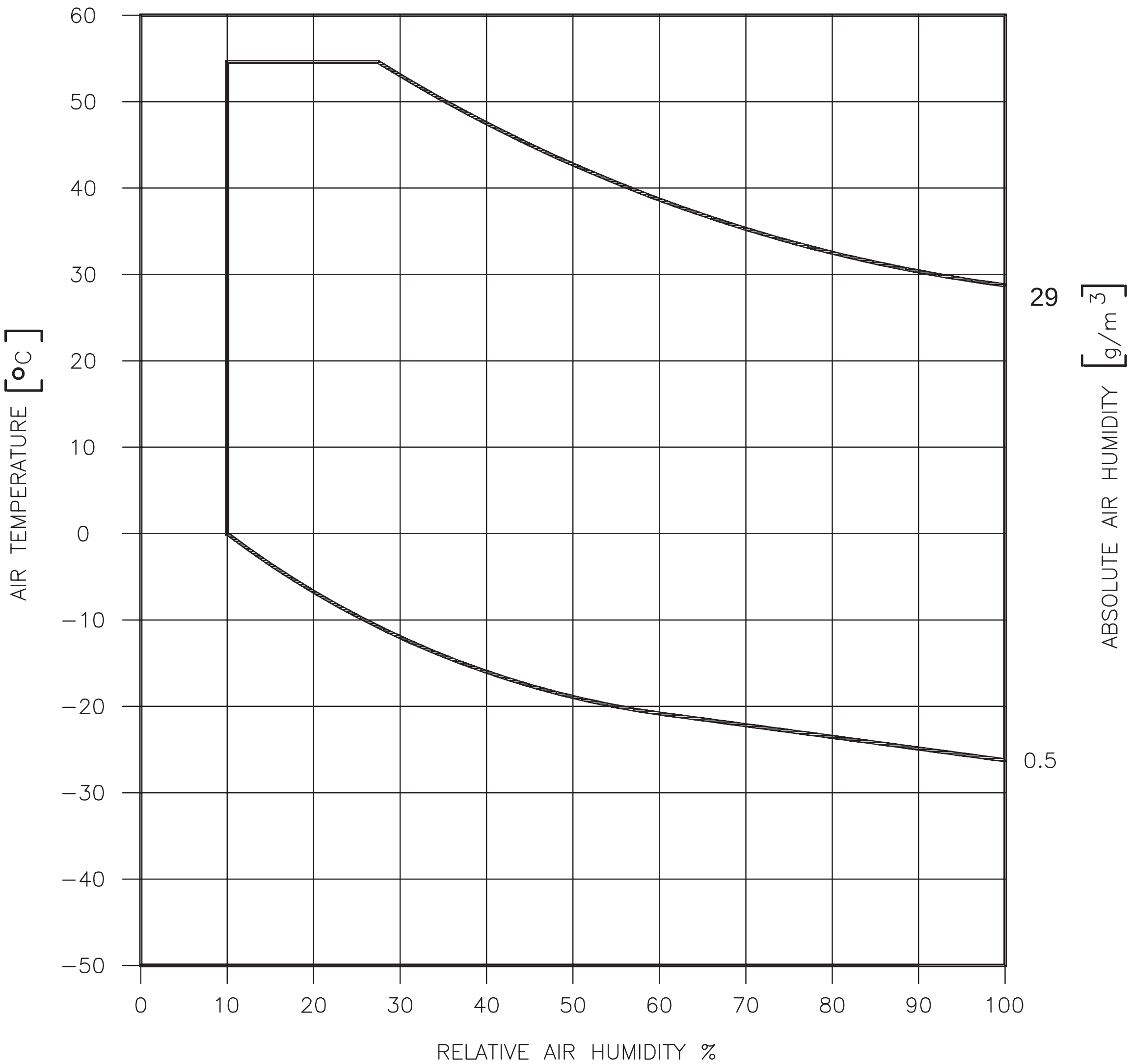


Figure 115. Climatogram for Class 1.2: not temperature controlled storage location

5.7.3 Transportation

The units are un–powered and packed in a “ready to ship“ condition prior to being subjected to the following transportation conditions. The packaging procedures and materials used have to be representative of those used for the final delivered product. The delivered product is: equipped racks, equipped subracks and individual units, unit design is compatible with all of these.

The 1626 LM equipment meets the following requirements Vs. transportation :

ETS 300 019–1–2 : 1992, class 2.2

Class 2.2 : Careful transportation (see Table 23. on page 239).

This class applies to transportation where special cars has been taken e.g. with respect to low temperature and handling.

Class 2.2 covers the condition of class 2.1. In addition class 2.2 includes transportation in all types of lorries and trailers in areas with well–developed road system.

It also includes transportation by ship and by train specially designed, shock–reducing buffers. Manual loading and unloading of to 20 Kg is included.

Extension of extreme low temperature during transportation is permitted for the 1626 LM equipment in its standard packing :

AT –40° C for 72 Hours maximum

without damaging the Optical interfaces.

Table 23. Transportation climatic

Environmental parameter		Unit	2.1 and 2.2	2.3
(A)	low temperature air	°C	– 25	– 40
(B)	high temperature, air in unventilated enclosures (NOTE 1)	°C	+ 70	+ 70
(C)	high temperature, air in ventilated enclosures or outdoor air (NOTE 2)	°C	+ 40	+ 40
(D)	change of temperature air/air (NOTE 3)	°C	–25 / +30	–40 / +30
(E)	change of temperature air/water (NOTE 3)	°C	+40 / +5	+40 / +5
(F)	relative humidity, not combined with rapid temperature changes	% °C	95 +40	95 +45
(G)	relative humidity, combined with rapid temperature changes air/air, at high relative humidity (NOTE 3 , 6)	% °C	95 –25 / +30	95 –40 / +30
(H)	absolute humidity, combined with rapid temperature changes : air/air at high water content (NOTE 4)	g/m^3 °C	60 +70 / +15	60 +70 / +15
(I)	low air pressure	KPa	70	70
(J)	change of air pressure	KPa/min	no	no
(K)	movement of the surrounding medium, air	m/s	20	20
(L)	precipitation rain	mm/min	6 (NOTE 7)	6
(M)	radiation, solar	W/m^2	1120	1120
(N)	radiation, heat	W/m^2	600	600
(O)	water from sources other than rain (NOTE 5)	m/s	1 (NOTE 7)	1
(P)	wetness	none	conditions of wet surfaces	

Notes on next page.

Notes to Table 23. :

NOTE 1 :	The high temperature of the surfaces of a product may be influenced by both the surrounding air temperature, given here, and the solar radiation through a window or another opening.
NOTE 2 :	The high temperature of the surface of a product is influenced by the surrounding air temperature, given here, and the solar radiation defined below.
NOTE 3 :	A direct transfer of the product between the two given temperature is presumed.
NOTE 4 :	The product is assumed to be subjected to a rapid decrease of temperature only (no rapid increase). The figures of water content apply to temperatures down to the dew–point; at lower temperatures the relative humidity is assumed to be approximately 100 %.
NOTE 5 :	The figure indicates the velocity of water and not the height of water accumulated.
NOTE 6 :	Occurrence of condensation.
NOTE 7 :	For short duration only.

5.7.4 Electromagnetic Compatibility (EMC) Requirements

All units when mounted in the appropriate subrack meet the EMC requirements as outlined in the **ETSI specification EN 300 386** (**V1.3.1** – required for CE marking) which covers equipment used within the telecommunication centre environment.
The applicable tests from these specifications are provided in the following tables.

Test references are also provided, each test reference specified contains details on the methods to be applied for that test.
The units when mounted in subracks, meet the requirements for enclosure, signal lines, DC power ports and radiated magnetic field emission.
The units, however, are not required to meet these requirements when not mounted in a subrack.

In addition to the requirements of EN 300 386 specification, the equipment meets the additional requirements of ES 201 468 ("Additional Electro Magnetic Compatibility (EMC) requirements for Telecommunications Equipment for Enhanced Availability of Service in Specific Conditions").

EMI/EMC condition are described in para. 4.1 on page 29.

MAINTENANCE

6 MAINTENANCE

WARNING **EMC NORMS**

WHEN CARRYING OUT THE GIVEN OPERATIONS OBSERVE THE NORMS STATED IN PARA. 4.1.3 ON PAGE 30

6.1 Maintenance introduction

6.1.1 General safety rules

SAFETY RULES

Carefully observe the front–panel warning labels prior to working on optical connections while the equipment is in–service.

Should it be necessary to cut off power during the maintenance phase, proceed to switch off the power supply units as well as cut off power station upstream (rack or station distribution frame)

SAFETY RULES

A TNV–2 (battery) voltage could be present on “R/M interface connector” (cable side); do not touch the pins when unplugged.

DANGER: Possibility of personal injury. Short circuiting, low-voltage, low-impedance, dc circuits can cause severe arcing that can result in burns and/or eye damage. Remove rings, watches, and other metal jewelry before working with primary circuits. Exercise caution to avoid shorting power input terminals.

SAFETY RULES

DANGER: Possibility of eyes damage: read carefully and strictly observe the rules pointed out in para. 3.2.4.2 on page 25.

6.2 General rules

- Check that the equipment is operating with all the shields properly positioned (dummy covers, ESD connector protections, etc)
- In order to reduce the risk of damaging the electrostatic sensitive devices, it is mandatory to use the elasticized band (around the wrist) and the coiled cord joined connect with the ground rack when touching the equipment.

6.3 Maintenance aspects

Maintenance consists of a set of operations which maintain or bring back the assembly to optimum operating conditions in a very short time, with the aim of obtaining maximum operational availability.

Maintenance is classified as:

- ROUTINE (PREVENTIVE)
- CORRECTIVE

6.4 Instruments And Accessories

There is a local terminal (PC) which permits to display all the alarms and manages the Equipment. The relative processing is described in the operator's handbook.

Where TMN is implemented, an Operation System displays alarms and manages all the connected Equipments of the network. Refer to the relevant handbooks.

The need of special tools and accessories to perform possible routine and corrective maintenance procedures is described inside the procedures themselves.

6.5 Routine maintenance

Routine maintenance is a periodic set of measurements and checks. This maintenance aims at detecting those devices whose function has deteriorated with time and therefore needs adjustment or replacement.

Typically, digital equipment requires no routine maintenance.

The equipment allows to assess the quality of the connection links for SECTION and PATH, counting the error events and obtaining the performance data.

The performance Monitoring application, described in the Operator’s handbook, allows this function.

6.5.1 Routine Maintenance every six months

It is suggested to carry out the following operations every six months:

- no–dust filter cleaning

6.5.1.1 No–dust filter cleaning / substitution

NO–DUST FILTER CLEANING / SUBSTITUTION

(caution to avoid equipment damage)

WARNING: BEFORE INSTALLING OR REMOVING THE NO–DUST FILTER, CHECK THAT THE PROTECTIVE ADHESIVE FILM HAS BEEN REMOVED.

SAFETY RULES

DANGER: Possibility of personal injury. Personal injury can be caused by rotating fans.

- Replace the no–dust filter from the FANS as follow:
  - unscrew the screws that ensure the no–dust filter to the fans
  - extract the no–dust filter and clean it
  - insert the no–dust filter back
  - ensure the no–dust filter to the FANS using the relevant screws

Note: the six–month period is only indicative; according to the environmental conditions could be necessary to reduce this period.

6.5.2 Routine Maintenance every year

It is suggested to carry out the following operations yearly:

- power cables check

6.5.2.1 Power cables check

SAFETY RULES

DANGER: Possibility of personal injury. Personal injury can be caused by –48 V dc.

DANGER: Possibility of personal injury. Short circuiting, low-voltage, low-impedance, dc circuits can cause severe arcing that can result in burns and/or eye damage. Remove rings, watches, and other metal jewelry before working with primary circuits. Exercise caution to avoid shorting power input terminals.

It is suggested to carry out the following operations

- Check that the power cable is perfectly safety grounded.
- Make sure that the subrack has been tightly fastened to the rack with screws, to guarantee grounding (the rack is connected to the station ground).

6.5.3 Routine Maintenance every five years

It is suggested the replacement of each FANS1000 unit after **five** years of working.

6.6 Corrective maintenance (troubleshooting)

Since the Troubleshooting procedure is carried out with the use of the Craft Terminal, please refer for details to the Maintenance Section of the Operator's Handbook.

FIXING THE UNITS (AND MODULES) INTO THE SUBRACK

(caution to avoid equipment damage)

The screw tightening torque for fixing the units (and modules, if any and if fixed by screws) into the subrack must be:

2.8 kg x cm (0.28 Newton x m) ± 10 %

Exceeding this value may result in screw breaking.

The following paragraph can be used as an help during corrective actions.

6.6.1 FANS1000 substitution

SAFETY RULES

DANGER: Possibility of personal injury. Personal injury can be caused by –48 V dc.

DANGER: Possibility of personal injury. Short circuiting, low-voltage, low-impedance, dc circuits can cause severe arcing that can result in burns and/or eye damage. Remove rings, watches, and other metal jewelry before working with primary circuits. Exercise caution to avoid shorting power input terminals.

When an hardware failure alarm of the FANS is raised (i.e. it is displayed on C.T or O.S. and it is also displayed on TRU) it means that at least one fan is broken and it is necessary to replace the FANS1000 unit. These alarm indications are also displayed on the FANS1000 front panel.

To substitute the faulty FANS1000 unit (red led ON) :

– unscrew the screws that ensure it to the rack

– substitute the faulty unit

– ensure the new FANS1000 unit to the rack using the relevant screws.

6.7 Set of spare parts

6.7.1 Suggested Spare Parts

The overall number of spares depends on Customer requirements, and should be based on the average amount of transmission circuits available to be accounted for not only during MTBF but also during MTTR; the latter depending on the amount of spare parts available and the time needed to repair the board.
The set of spare parts is inclusive of a minimum number of spares for each type of replaceable plug–in unit (see unit list in paragraph 2.2.3 on page 86).

6.7.2 General rules on spare parts management

Before storing the spare units make sure that they are working by inserting them in an operating equipment
It is suggested to periodically check those spare units have not been utilized for over a year.
If the spare parts and the equipment are stored in the same environment, make sure that the spare parts are placed in cabinets to safeguard them from dust and damp.
Moreover, they should also be well grounded to avoid electrostatic discharges.

If the spare parts are stored in another room, or have to be moved from another place, building or site, make sure that the following is observed:

– the spare parts must be wrapped in anti–static and padded envelopes;

– the spare parts must not touch wet surfaces or chemical agents that might damage them (e.g. , gas);

– if during transport the temperature is lower than that of the room where they had been kept, make sure that before using them they pass a certain period in a climatic chamber to prevent thermal shocks and/or the possibility of steaming up.

When replacing a unit/sub–unit, make sure that the spare unit/sub–unit is set exactly as the replaced one. For the presettings procedures see section HARDWARE SETTING DOCUMENTATION.

6.7.3 Particular rules on spare parts management

Whenever some units with flash-memories are common to different kinds of equipment or to different versions of the same type of equipment, it is possible to maintain one spare part only: this allows spare part stock saving, even though software downloading will be necessary when the software loaded into the unit (program part or data part) is different from that necessary in the equipment where the spare unit must be used.
At the end of the commissioning phase or after an equipment data change, it is suggested to save the equipment data, e.g. on floppy disk, and store this floppy disk in the spare part stock pointing out the equipment it refers to.

6.8 Repair Form

To facilitate repair operation, data on the faulty unit must be reported on the form shown in Figure 116. on page 251.
The repair form must be filled–in with as much data as possible and returned to Alcatel together with the faulty unit.

ALCATEL

REPAIR FORM

Fill in this form and affix it to the faulty unit to be returned to Alcatel

TO BE FILLED IN BY THE SENDER

CUSTOMER NAME

ORDER NUMBER/CONTRACT NUMBER

SITE

BRANCH/UNIT/COUNTRY

SYSTEM/EQUIPMENT

PRODUCT RELEASE

EQUIPMENT SOFTWARE PART NUMBER

STATION/RACK

SUBRACK

SLOT

MNEMONIC

ALCATEL PART NUMBER

SERIAL NUMBER

FAULTY UNIT SOFTWARE VERSION

FAULT PHASE

INSTALLATION / TURN ON

OPERATION

MAINTENANCE

REASON FOR REPAIR

CLEAR FAULT

DROP IN PERFORMANCE

INTERMITTENT FAULT

UPGRADE/QUALITY ALERT

TEMPERATURE FAULT

PRESUMED CAUSE

INTERNAL

EXTERNAL

- LIGHTNING
- AIR COND.
- OTHER

FAULT STILL PRESENT AFTER REPAIR

DATE

NAME OF SENDER

COMMENTS

TO BE FILLED IN BY THE REPAIR OPERATOR

PROCESSING

NO FAULTS FOUND A

UPGRADE I

STANDARD REPAIRING B–D

NOT REPAIRABLE (REJECTED) M

QUALITY ALERT I

SUBSTITUTED S–X

FAULTS DETECTED

SOLDERING / WIRING C

COMPONENT F–L

ADJUSTMENT P

MECHANICAL V1

PRINTED CIRCUIT BOARD V1

DIRT V2

CORROSION V3

OTHER

NOTE : LETTERS ARE FOR FACTORY USE

COMMENTS

DATE

REPAIRING NUMBER

REPAIRING CENTRE

NAME OF REPAIR OPERATOR

Figure 116. Repair form

HARDWARE SETTING DOCUMENTATION

UNIT DOCUMENTATION LIST

This section contains the documents sheets to refer to for unit/sub–unit hardware setting options.
The list of the enclosed documents is given in Table 25. on page 258, according to the ANV part number.

TABLE EXPLANATION:

– **UNIT IDENTIFICATION P/Ns AND CHANGE STATUS**

Each unit or sub-unit is distinguished by:

- a dual Part No.:
  - Factory P/N (4xx.xxx.xxx xx)
  - ANV P/N (xxx.xxxxx xxxx) (**NOTE**)

NOTE The last two ANV-P/N letters (in the following stated as **'suffix'**) stand for a "feasible alternative", they might differentiate two units even though still functionally compatible. For this reason the indicated ANV P/N does not include the last two letters.
For example : the units having P/Ns "3AL–34065–AAAA" and "3AL–34065–AABA" are functionally compatible and, as regards to hardware settings, the **MSxxx** document (described hereafter) 3AL–34065–AAAA-MSxxx is applicable for both.

- and by a pair of design & production series (change status):
  - **CS**, associated to the Factory P/N (4xx.xxx.xxx x)
  - **ICS**, associated to ANV P/N (xxx.xxxxx xx)

The following table shows an example of correspondence between **"FACTORY P/N + CS"** and **"ANV P/N + ICS"**

Table 24. Example of correspondence between CS and 'suffix + ICS'

N.B. The P/Ns used in this example have no correspondence with those of the actual equipment part list!

FACTORY CODE		ANV CODE	
P/N	CS	P/N	ICS
487.156.612	01	3AL 34422 AA AA	01
487.156.612	02	3AL 34422 AA AB	01
487.156.612	03	3AL 34422 AA AC	01

In this example you can see that the production series is identified only by the CS as far as the Factory code is concerned, and by the 'suffix + ICS' if the ANV code is referred to.

Some of the possible positions of the label indicating the unit's P/Ns and CS–ICS are illustrated in para.4.4 on page 32.

– **CROSS–REFERENCE**

- **Id.** Unit alphabetical notation. It indicates the unit containing one or more subunits.
- **App.** It reports the unit notation (Id) to which the sub–unit belongs.

The hardware settings can be executed after having checked all the sub–units belonging to a unit, by considering the above cited cross–reference, and by using the presetting documents indicated in the table and presented in the following point.

– **ENCLOSED DOCUMENTS**

For each type of unit or sub-unit having setting options that can be customized, the document

”ANV P/N”–MSxxx

is annexed to this handbook (in the case of Documentation on CD-ROM the **MSxxx** documents may be given in a CD-ROM different from that containing this Technical Handbook).

The **MSxxx** documents are enclosed in numerical order. The Edition of the enclosed **MSxxx** document is the highest available on the date on which the Technical Handbook is assembled.

Use of the document **MSxxx**:

- **MSxxx** means ”document for hardware presetting options” (the **MSxxx** document’s Part No. is as that of the unit or sub-unit and its **MS** acronym defines type).
  The **xxx** part of **MSxxx** is relevant to ANV internal identification codes.

- As the Customer may have to manage many units of the same type (same P/N) but with different CS–ICS, the document **MSxxx** describes with possible different chapters the different setting options, according to all the possible CSs–ICSs. For this purpose, a table at the beginning of document (**PREFACE**) indicates the chapter to be used according to the CS or the corresponding ’suffix + ICS’, taking into account that:
  - a change of the production series does not necessarily imply a change in the setting options;
  - a change of the ANV P/N suffix does not imply a new **MSxxx** document;
  - the CS, SUFFIX and ICS must be meant as:
    - **from** specified CS, SUFFIX or ICS (**included**)
    - **to** next CS, SUFFIX or ICS (**excluded**) if listed
  - the sequence of CSs is increasing from alphanumeric to numeric (e.g. CS=A0 is lower than CS=01).

  Each chapter contains:

  - one or more tables defining the relationship between the functions achievable and the setting options to make;
  - the unit layout drawing which shows the exact location of all the setting options.

  N.B. SZ1 IDENTIFIES PIN 1 OF COMPONENT

  The setting options described in the documents **MSxxx** must be used according to 3AL377470001 (962.000.022 F) MSxxx document, inserted in Table 25. on page 258, which shows the ’ON’ (closed) position of micro–switches.
  Those setting options that on the table are indicated by the caption **For factory use only** should never be modified.

EXAMPLE

N.B. The P/Ns used in this example have no correspondence with those of the actual equipment part list!

Taking into account the same unit of Table 24. on page 255:

FACTORY CODE		ANV CODE	
P/N	CS	P/N	ICS
487.156.612	01	3AL 34422 AAAA	01
487.156.612	02	3AL 34422 AAAB	01
487.156.612	03	3AL 34422 AAAC	01

and supposing that the setting options valid for CS=01 are equal to those for CS=02, but change for CS=03, the table at the beginning of the document 3AL 34422 AAAA MSZZQ will be:

CHAPTER *CAPITOLO*	FACTORY P/N *CODICE DI FABBRICA*	ANV P/N *CODICE ANV*	
	FROM CS *DA CS*	FROM SUFFIX *DA SUFFISSO*	FROM ICS *DA ICS*
1	01	—AA	01
2	03	—AC	01

If you have the unit identified by one of this identification data:

FACTORY CODE		ANV CODE	
P/N	CS	P/N	ICS
487.156.612	01	3AL 34422 AAAA	01
487.156.612	02	3AL 34422 AAAB	01

you will use **Chapter 1** of document **3AL 34422 AAAA MSZZQ**

If you have the unit identified by one of this identification data:

FACTORY CODE		ANV CODE	
P/N	CS	P/N	ICS
487.156.612	03	3AL 34422 AAAC	01
487.156.612	04	3AL 34422 AAAD	01

you will use **Chapter 2** of document **3AL 34422 AAAA MSZZQ**

Table 25. Hardware presetting documentation

The edition of the documents (listed in this table) that are physically enclosed in the handbook is the highest available when this handbook is assembled. The edition of enclosed documents is not specified in this table.

Only the boards that need hardware settings are listed in this table

Id	NAME	App	ANV P/N (Factory P/N)	Document for hardware presetting
1	ESCT1000		3AL 94304AA—	–
2	CMDX 1010 1:8 B1 CH MUX/DEMUX		3AL 95507 AA—	–
3	CMDX 1010 1:8 B2 CH MUX/DEMUX		3AL 95507 AB—	–
4	CMDX 1010 1:8 B3 CH MUX/DEMUX		3AL 95507 AC—	–
5	CMDX 1010 1:8 B4 CH MUX/DEMUX		3AL 95507 AD—	–
6	CMDX 1010 1:8 B5 CH MUX/DEMUX		3AL 95507 AE—	–
7	CMDX 1010 1:8 B6 CH MUX/DEMUX		3AL 95507 AF—	–
8	CMDX 1010 1:8 B7 CH MUX/DEMUX		3AL 95507 AG—	–
9	CMDX 1010 1:8 B8 CH MUX/DEMUX		3AL 95507 AH—	–
10	CMDX 1010 1:8 B9 CH MUX/DEMUX		3AL 95507 AJ—	–
11	CMDX 1010 1:8 B10 CH MUX/DEMUX		3AL 95507 AK—	–
12	CMDX 1010 1:8 B11 CH MUX/DEMUX		3AL 95507 AL—	–
13	CMDX 1010 1:8 B12 CH MUX/DEMUX		3AL 95507 AM—	–
	EC / SC control board	1	3AL 94306 AA—	3AL 94306 AAAA MSZZQ
	MUX/DEMUX common PBA	2,3,4,5,6,7 8,9,10,11, 12,13	3AL 95510 AA—	3AL 95510 AAAA MSZZQ

END OF DOCUMENT

Technical Handbook

Alcatel
1626 LM

96/192 Channels Core DWDM Platform

1626 LM REL.2.0

3AL 94936 AAAA Ed.01

ALCATEL

3AL 94936 AAAA Ed.01