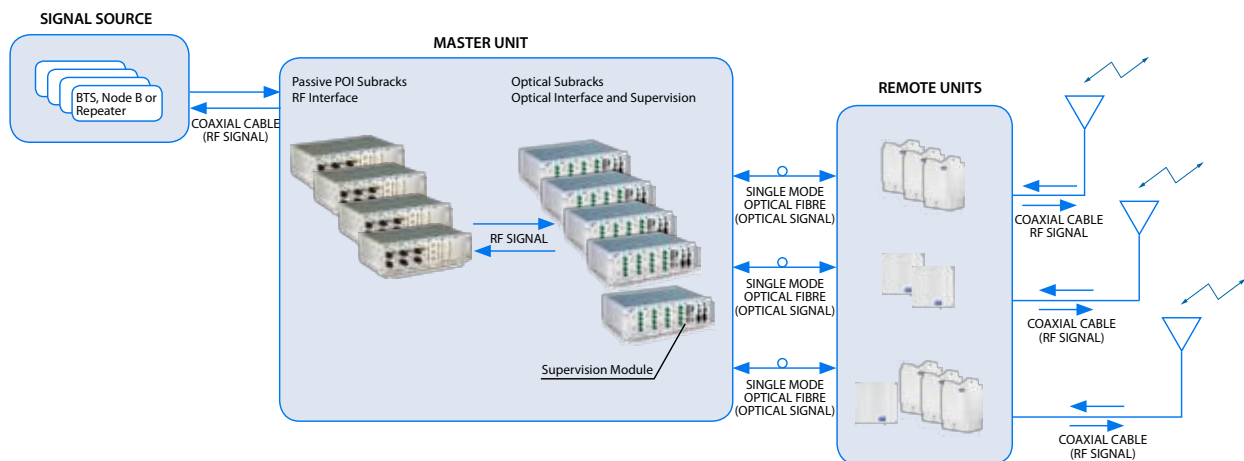# 1.General Description

1. Teko Telecom Optical Systems - General Description

Teko Telecom Optical Systems are flexible multi-band multi-operator modular systems that provide both indoor and outdoor cellular coverage in shadow areas -where RF signal is not available- or capacity in hot spots -where the operators want a dedicated coverage.
They are based on the Radio over Fibre technology, which enables radio signals transmission over optical fibres.

Each Optical System is made up of two main parts, Master Unit and Remote Units, connected via single mode optical fibres (SMR 9/125).

Master Unit is a rack-based modular equipment which provides both RF connection towards the signal source (one or more BTSs, Node Bs or repeaters) and the optical interface towards Remote Units. It also hosts the Supervision Module for the management of the whole System.

Remote Units distribute capacity or extend coverage into different locations at distances up to 20km (12.4miles) from the Master Unit. They can be Single, Dual or Tri-band with four different RF power classes: Very High, High, Medium and Low.
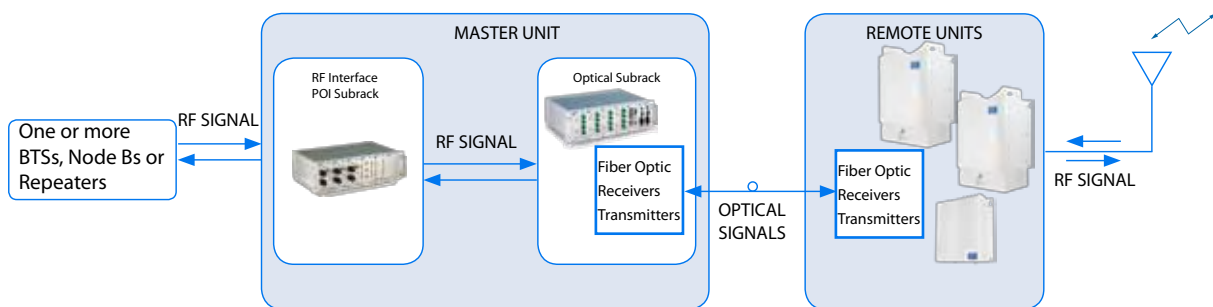
A single Master Unit can drive up to 144 Remote Units. Various network structures can be supported by the Master Unit: the Remote Units of the same Optical System can be deployed with a point-to-point connection (star-configuration - using one fiber optic per Remote Unit) or with cascading of up to 5 Remote Units using a single fibre and optimized optical couplers.

1.1 Operating Principle

Teko Telecom Optical Systems are based on the Radio over Fiber Concept: in Downlink RF signals are converted into optical signals in the Fiber Optic Transmitter modules of the Master Unit and then they are propagated through optical fibre distribution to Remote Units. In the Fiber Optic Receiver of each Remote Unit, the optical signal is then converted back into an RF signal that is amplified and transmitted to mobiles through an antenna or a passive distribution system.

In Uplink RF signal is converted into an optical signal in the Fiber Optic Transmitter of each Remote Unit and then it is propagated via fibre optics to the Master Unit. Optical signals from Remote Units are then converted by the Fiber Optic Receiver modules of the Master Unit into RF signals and transmitted to the signal recipient.

Uplink and downlink optical signals are transmitted over the same single mode optical fibre (Wavelength Division Multiplexing -WDM- technology).

Optical Systems management

Teko Telecom Optical Systems can be set and managed locally via the LAN port of the Supervision Module of the Master Unit. For remote control the system can be accessed via Ethernet, via external PSTN or wireless modem or via optional built-in wireless modem.

Teko Telecom Operation and Maintenance Terminal (OMT) software allows the commissioning, monitoring, setting and troubleshooting of the whole Teko Telecom Optical System.

The access to the System is performed via web pages: the Supervision Module is equipped with a web-server and each component of the System is associated to a web page displaying detailed information about the component.

The Supervision Module is also equipped with an SNMP-agent, which allows to control each parameter of the system via SNMP get/set/trap operations.

Teko Telecom Operation Management Centre (OMC) proprietary software allows the management of multiple Teko Telecom Optical Systems in a Network.

OMC is a client-server application: the server collects and stores information, such as System status and alarms, relevant to each Optical System in the network. The Server communicates with each System Supervision Module via Ethernet (TCP-IP socket) or via PSTN or wireless modem.

The Client provides access to the information stored in the Server database. It allows end-users to check the status of the Optical Systems in the network via a user friendly graphical interface.

1.2 Technical Specifications

This paragraph makes Master Unit and Remote Units mechanical, environmental and power supply specifications available. Please refer to each product datasheet for detailed electrical specifications. Contact Teko Telecom Sales Office for further information.

- **Master Unit**

Dimensions	19"-3U racks / depth 270 mm (10.63 in)
Power supply	85÷264Vac (50-60Hz) (TPSU/AC) -72÷-36Vdc (TPSU/48)
Operating temperature range	-5°C up to +45°C (+23°F up to +113°F)

- **Remote Units**

LOW POWER				
Dimensions (HxWxD)	**Weight**	**Operating temperature range**	**Degree of protection (IP)**	**Power supply**
350x350x100mm (13.78x13.78x3.94 in) max volume - heat sinks and connectors included	13 kg (28.7 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP32 (box) IP66 (with optional protection kit)	85÷264Vac (50-60Hz) /AC version -72 ÷ -36Vdc /48 version

	SMR700 Low	**SMR700 High**	**SMR900 (*)**
UL Operating Freq. band	698 – 716 MHz	776 – 787 MHz	896 – 902 MHz
DL Operating Freq. band	728 – 746 MHz	746 – 757 MHz	935 – 941 MHz
DL RF gain, in Master Unit tx	34 dB	34 dB	34 dB
UL RF gain, out Mater Unit tx	47 dB	47 dB	47 dB
DL output power	29dBm (1 carrier) Mod.: LTE	29dBm (1 carrier) Mod.: LTE	29dBm (1 carrier) Mod.: iDEN (QAM)

(*) including SMR900 band (UL: 896 - 901 MHz / DL: 935 - 940 MHz) and Narrow Band PCS (UL: 901 - 902 MHz / DL: 940 - 941 MHz).

VERY HIGH POWER				
Dimensions (HxWxD)	**Weight**	**Operating temperature range**	**Degree of protection (IP)**	**Power supply**
620x415x260mm (24.41x16.34x10.24 in) max volume - heat sinks, handles and connectors included	Triband: 38 kg (83.78 lbs) Dualband: 37 kg (81.57 lbs) Single band: 36 kg (79.37 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66 (with optional pro-tection kit)	85÷264Vac (50-60Hz)

	SMR700 Low	**SMR700 High**	**SMR900 (*)**
UL Operating Freq. band	698 – 716 MHz	776 – 787 MHz	896 – 902 MHz
DL Operating Freq. band	728 – 746 MHz	746 – 757 MHz	935 – 941 MHz
DL RF gain, in Master Unit tx	48 dB	48 dB	48 dB
UL RF gain, out Mater Unit tx	47 dB	47 dB	47 dB
DL output power	43dBm (1 carrier) Mod.: LTE	43dBm (1 carrier) Mod.: LTE	43dBm (1 carrier) Mod.: iDEN (QAM)

(*) including SMR900 band (UL: 896 - 901 MHz / DL: 935 - 940 MHz) and Narrow Band PCS (UL: 901 - 902 MHz / DL: 940 - 941 MHz).

1.3 Master Unit

The rack-based modular Master Unit can be composed of multiple 19"-3U subracks: it can be equipped with one or more Point of Interface (POI) subracks and with one or more Optical Subracks to offer maximum System flexibility.

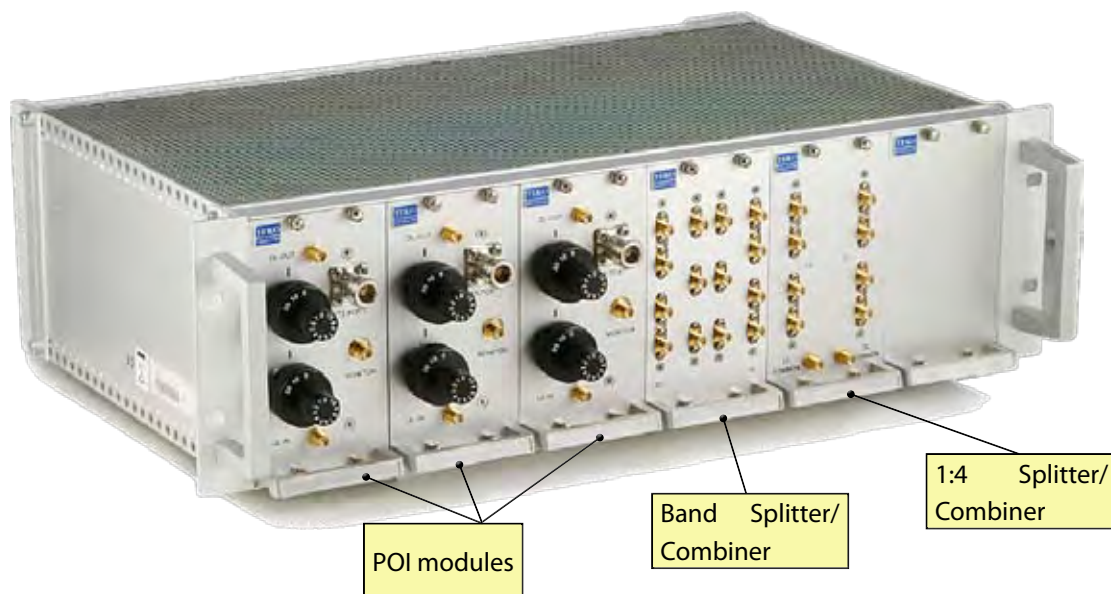**POI subracks** provide the RF interface towards the signal source.

Optical Subracks provide the optical interface towards the Remote Units. The Master Optical Subrack hosts the Supervision Module for the management of the whole Optical System.

1.3.1 POI Subracks - SUB-HPOI

POI subracks can operate over different frequencies and with various frequency combinations in the frequency range from 380 to 2200MHz.

Each POI subrack can host different passive modules, depending on the application scenario:

- Point of Interface (POI) modules,
- 1:4 Splitter/Combiner
- Band Splitter/Combiner (Triplexer) with built-in 1:4 Splitter/Combiner.

1:4 Splitter/Combiner

Band Splitter/Combiner

POI modules

Example: passive POI subrack equipped with 3 POI modules operating in different bands, 1:4 Splitter/Combiner, Band Splitter/Combiner with built-in 1:4 Splitter/Combiner

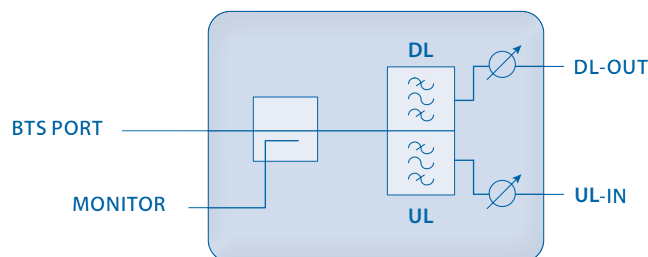- **Point Of Interface (POI) Modules**

POI modules are used to interface any kind of operator signal source -pico/micro/macro BTS, NodeB or Repeater: each POI module is connected to a single mobile operator/ mobile standard signal source via coaxial cable.

Each POI subrack in a System can be equipped with one Point of Interface or more Point of Interface modules to make multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).

Each POI module includes the duplexer, necessary to separate/combine Downlink and Uplink paths, and two adjustable attenuators to make both Downlink and Uplink RF levels adjustable within a range of either 30dB, with 1dB step, or 10dB, with 1dB step (POI-10dB models).

A monitor port is available either for measurements or for external wireless modem coupling.

POI module block diagram

POI modules with separate Downlink and Uplink ports (without built-in duplexer) are available as option.

Point of Interface Modules Access Points

POI with built-in duplexer

POI without built-in duplexer

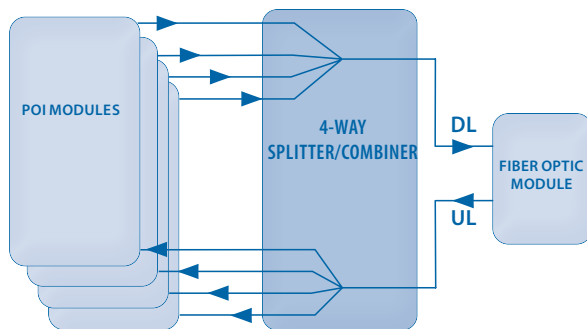| RF Connectors	Description
DL-OUT	Downlink path RF output (SMA connector)
UL-IN	Uplink path RF input (SMA connector)
BTS PORT	RF connector (N type) towards the signal source (BTS, Node B or repeater)
MONITOR	Monitor port for measurements or for connection to a modem for remote management

RF Connectors	Description
DL-OUT	Downlink path RF output SMA connector
UL-IN	Uplink path RF input SMA connector
BTS PORT DL	Input RF connector from the signal source - BTS, Node B or repeater (N type)
BTS PORT UL	Output RF connector to the signal source - BTS, Node B or repeater (N type)

Adjustable attenuators	Description
DL OUT	Downlink path RF level adjustable attenuator (0÷30dB or 0÷10dB - 1 dB step)
UL IN	Uplink path RF level adjustable attenuator (0÷30dB or 0÷10dB - 1 dB step)

MetaSystem
Group

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TEKO
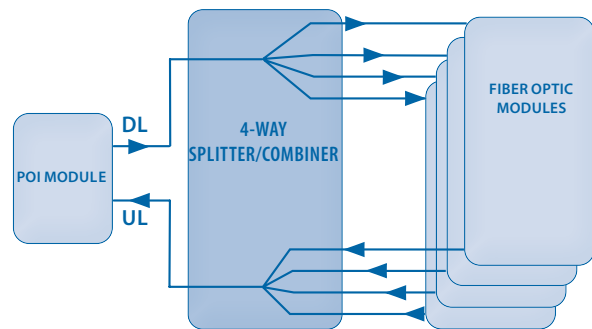TELECOM

www.tekotelecom.it

- **4-way Combiner/Splitter Module**

The 4-way Combiner/Splitter can be used to manage either up to 4 POI modules operating in the same band (Multi-Operator Optical Systems) or up to 4 Fiber Optic Transmitter/Receiver Modules (Single-Band Optical Systems).
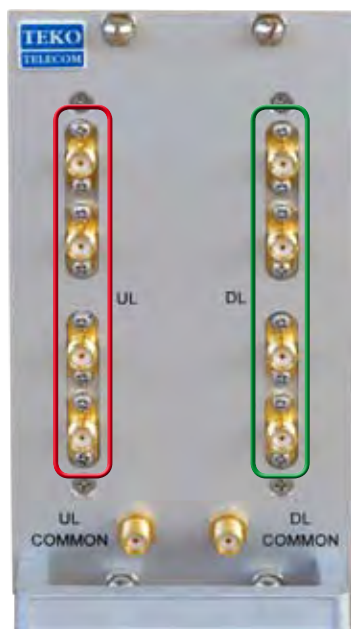

4-way combiner (DL side) / 4-way splitter (UL side) to manage up to 4 POI modules operating in the same band

4-way splitter (DL side) / 4-way combiner (UL side) to manage up to 4 Fiber Optic Transmitter/Receiver Modules

4-way Combiner/Splitter module block diagrams

4-way Combiner/Splitter Module Access Points

Connectors		Description		
UL	WHEN USED TO MANAGE MULTIPLE POI MODULES	Up-link path output SMA connectors (to POI modules)	WHEN USED TO MANAGE MULTIPLE FIBER OPTIC MODULES	Up-link path input SMA connectors (from optical sub-racks)
UL COMMON		Up-link path input SMA connector		Up-link path output SMA connector
DL		Down-link path input connectors (from POI modules)		Down-link path output connectors (to optical sub-racks)
DL COMMON		Down-link path output		Down-link path input

- **Triplexer with built-in 4-way Combiner/Splitter**

The Triplexer is used in multi-band configurations to distribute signals operating in different bands. In Down-link it combines any low band signal in the 700 to 960MHz range (SMR, EGSM or AMPS for example), and DCS, UMTS (or PCS, AWS) signals; in Up-link it filters the composite signal into low band, DCS, UMTS (or PCS, AWS) signals.

The module also includes a 4-way Splitter/Combiner to drive up to 4 Fiber Optic Transmitter/ Receiver Modules.
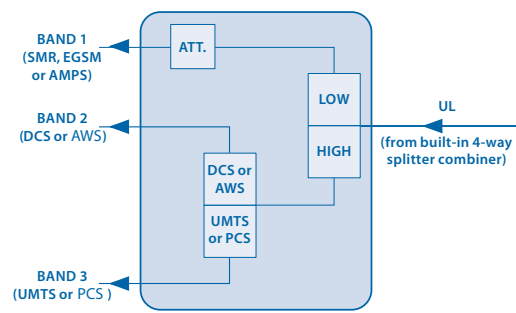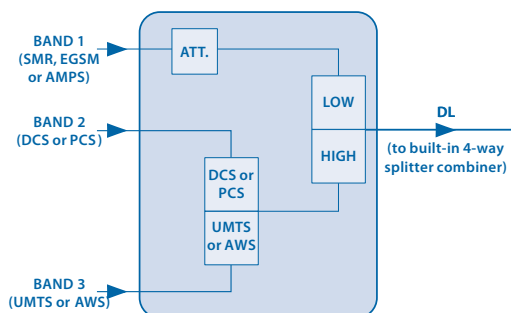
The triplexer can be used to manage *either* up to 3 POI modules operating in different bands and up to 4 Fiber Optic Transmitter/Receiver Modules *or* up to 3 four-way splitter/combiner - used to manage multiple POI modules (up to 4 for each band) - and up to 4 Fiber Optic Transmitter/Receiver Modules.

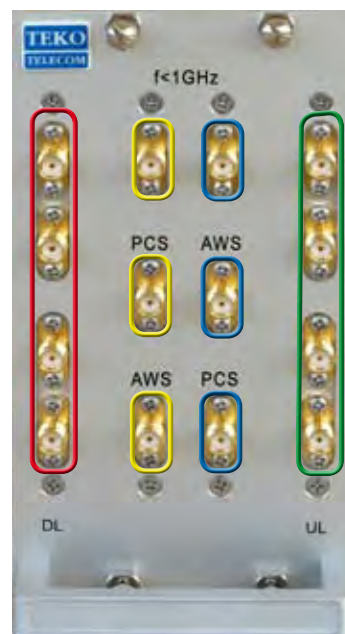EGSM, DCS, UMTS Triplexer with built-in 4-way Combiner/Splitter

AMPS, PCS, AWS Triplexer with built-in 4-way Combiner/Splitter

Triplexer block diagram

Triplexer Module Access Points

EGSM, DCS, UMTS Triplexer with
built-in 4-way Combiner/Splitter

AMPS, PCS, AWS Triplexer with
built-in 4-way Combiner/Splitter

Connectors		Description
EU Bands	US Bands	
EGSM	f<1GHz	Low band (700 to 960MHz) input (down-link path)
		Low band (700 to 960MHz) output (up-link path)
DCS	PCS	DCS or PCS input (down-link path)
	AWS	DCS or AWS output (up-link path)
UMTS	AWS	UMTS or AWS input (down-link path)
	PCS	UMTS or PCS output (up-link path)

UL	WHEN USED TO MANAGE MULTIPLE FIBER OPTIC MODULES	Up-link path input connectors (from optical subrack)	WHEN USED TO MANAGE MULTIPLE FOUR-WAY COMBINER/SPLITTER MODULES	Up-link path output connectors (to 4-way combiner/splitter modules)
DL		Down-link path output connectors (to optical subrack)		Down-link path input connectors (from 4-way combiner/splitter modules)

1.3.2 Optical Subracks - SUB-TRX

Master Unit Optical Subracks are the optical interface towards Remote Units: they host Fiber Optic Transmitter/Receiver modules for RF to optical /optical to RF conversion. Fiber Optic modules are connected to Remote Units via single-mode optical fiber (SMR 9/125); each Fiber Optic Module can manage up to 4 Remote Units (up to 5 in cascade configuration).

The Master Optical Subrack also hosts the Supervision Module for the management of the whole System.

Optical Subracks can be AC or DC powered. Power supply modules can be equipped either in monitored Optical Subracks or in the Master Optical Subrack.

The Supervision Module can manage the Optical Subrack it is equipped in (Figure A), and up to other 8 Optical Subracks, mounted within the same rack and monitored via RS485 connection. Eight numbered ports are available on the Supervision Module front panel: they allow connection to the RS485 ports of monitored Optical Subracks.

Each monitored Optical Subrack takes its address from the Supervision Module port it is connected to. The Optical Subrack equipped with the Supervision Module (Master Optical Subrack) takes address = 0 (zero).
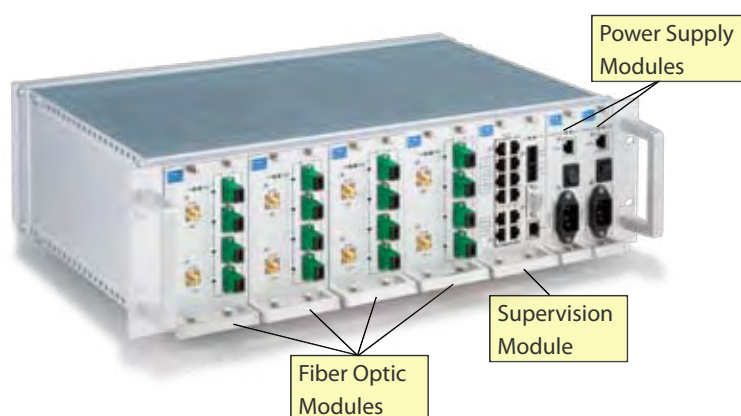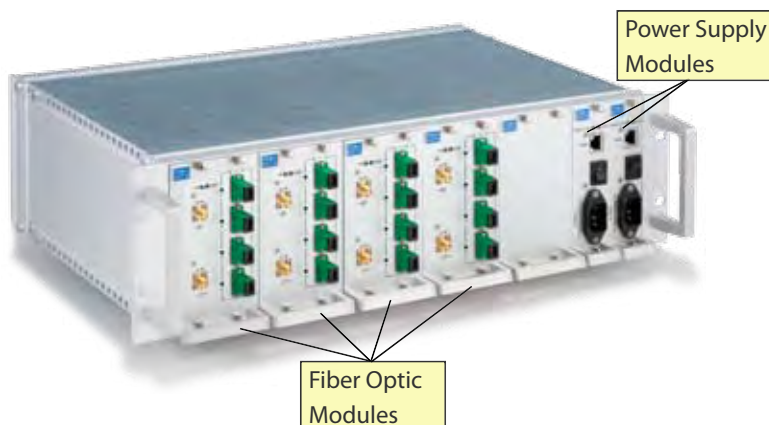

Power Supply Modules

Supervision Module

Fiber Optic Modules

Figure A - Example of Master Optical Subrack hosting the Supervision module, up to 4 Fiber Optic Transmitter/Receiver modules, and up to 2 Power Supply Modules (the second power supply module, optional, provides power supply redundancy for higher reliability)

Figure B - Example of monitored Optical Subracks equipped with 4 Fiber Optic Transmitter/Receiver Modules and 2 Power Supply Modules

Power Supply Modules

Fiber Optic Modules

- **Supervision Module**

The Supervision Module (TSPV) allows to set and manage the entire Optical System.

Up to 9 fully equipped Optical Subracks (i.e. 144 Remote Units) can be monitored connecting a PC, either locally or remotely, to the Ethernet port (LAN, RJ45 connector), available on the Supervision Module front panel.

An RS232 port is available for remote control via an external PSTN or wireless modem.

The RS232 port is not available when the optional built-in wireless modem is equipped.

Supervision Module equipped with optional built-in wireless modem

Supervision Module with RS232 port

4 external alarms inputs and 4 dry contacts outputs are available on the Supervision module front panel.
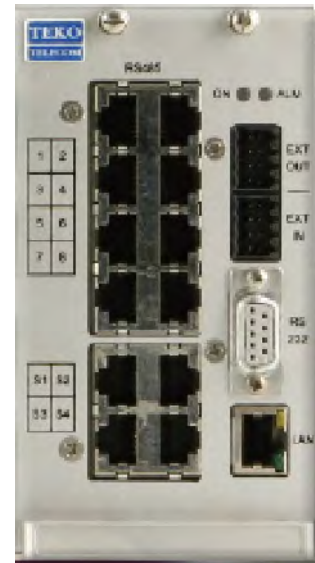
An embedded web server allows control and management of the Optical System via a standard web browser (OMT software).

Teko Telecom OMC proprietary software has been developed to allow the management of multiple Optical Systems in a Network.

Supervision Module Access Points

Supervision Module equipped with optional built-in wireless modem

Supervision Module with RS232 connector

Connectors	Description
RS485 (1 to 8)	RJ45 connectors for monitored Optical Subracks management
RS485 (S1 to S4)	RJ45 connectors for remote Slave Supervision Modules management
EXT OUT	Dry contacts output connector
EXT IN	External alarms input connector
RS232	9-pole D-Sub RS232 connector for connection to an external modem
ANT	Optional built-in modem input/output connector for remote management
LAN	RJ45 connector Local Control Interface

LEDs	Information
ON	Supervision Module operating status green LED: ON when power supply is present
ALM	Supervision Module alarm status LED. OFF: regular operation Blinking Orange: presence of active alarms with **warning** severity level (4) Orange: presence of active alarms with **minor** severity level (3) Blinking Red: presence of active alarms with **major** severity level (2) Red: presence of active alarms with **critical** severity level (1)

- **Fiber Optic Transmitter/Receiver Modules**

Fiber Optic Transmitter/Receiver Modules provide RF-to-Optical/Optical-to-RF conversion. They are connected to Remote Units via single mode optical fibers, with Uplink and Downlink signals transmitted over the same fibre (Wavelength Division Multiplexing -WDM technology).

Different modules configurations are available: a single Fiber Optic Transmitter/Receiver Module can be equipped with 1 Optical Transmitter and 1 Optical Receiver (10dB optical link budget, up to 20km distance - 12.4 miles), or 1 Optical Transmitter split by 2 and 2 combined Optical Receivers (10dB optical link budget, up to 20km distance- 12.4 miles), or 1 Optical Transmitter split by 4 and 4 combined Optical Receivers (6dB optical link budget, up to 10km distance - 6.2 miles).

The Fiber Optic Transmitter/Receiver Module in 1:1 configuration is able to drive up to 5 cascaded Remote Units with different wavelengths in Up-link.

Fiber Optic Transmitter/Receiver Module equipped with 1 Optical Transmitter split by 4 and 4 combined Optical Receivers
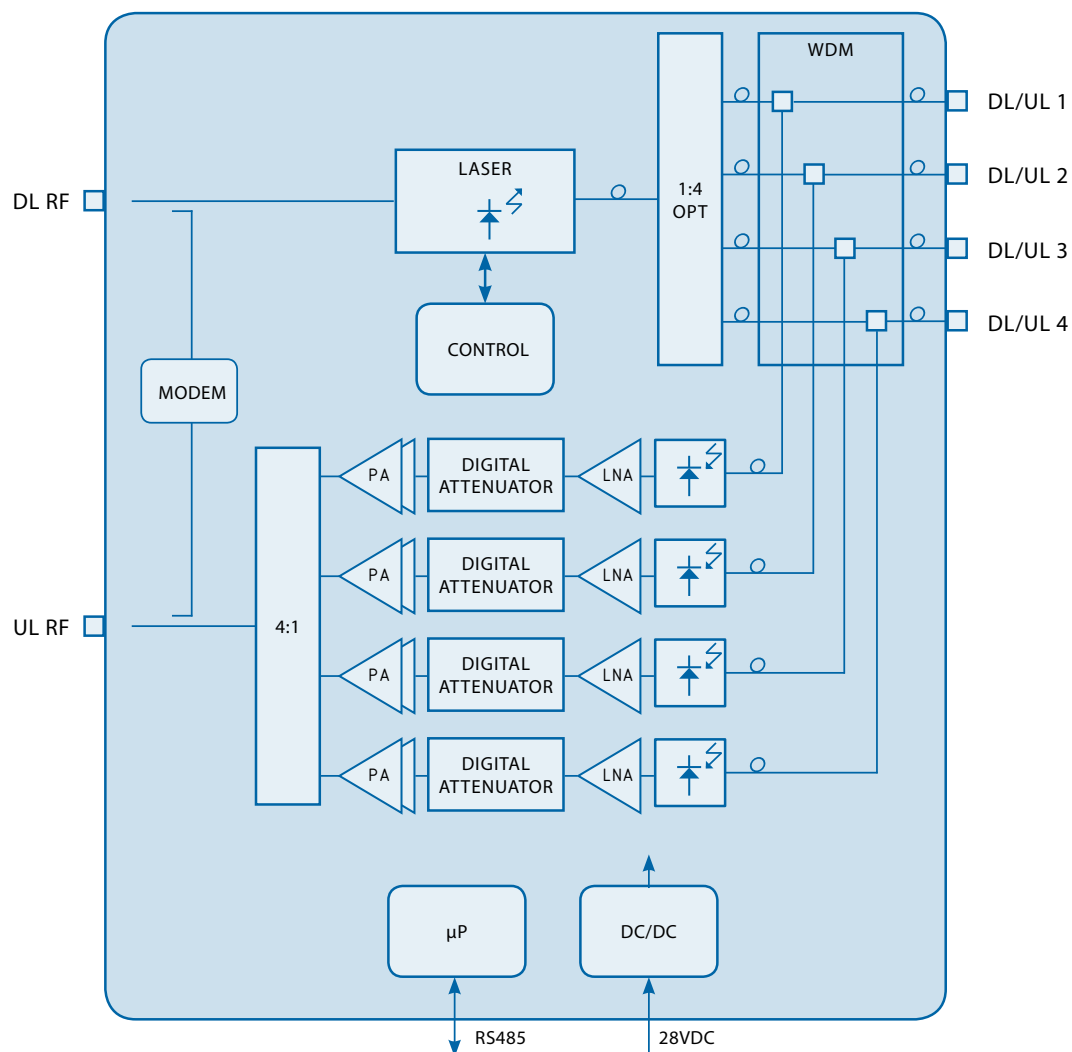
The Fiber Optic Transmitter provides RF to optical conversion (Downlink side): the module RF section covers the 380 to 2200MHz band.

Fiber Optic Receivers convert uplink optical signals from Remote Units into RF. They operate in the third window (Optical wavelength 1490 ÷ 1570 nm).

Each Fiber Optic module is controlled by a microprocessor which provides the following data to the Supervision Module:

- optical power received by each optical receiver,

- Downlink attenuator and Uplink attenuator attenuation setting (0 ÷ 15dB),

- received optical power alarms.

An auto-levelling functionality (AGC) compensates up to 10dB optical link loss in order to guarantee constant gain over different optical budgets. This feature simplifies system installation, makes commissioning quick and easy and avoids field adjustments.

Block diagram: Fiber Optic Transmitter/Receiver Module equipped with 1 Optical Transmitter split by 4 and 4 combined Optical Receivers (WDM technology)

Fiber Optic Transmitter/Receiver Module Access Points

Fiber Optic Module equipped with 1 Transmitter split by 4 and 4 combined Receivers - WDM
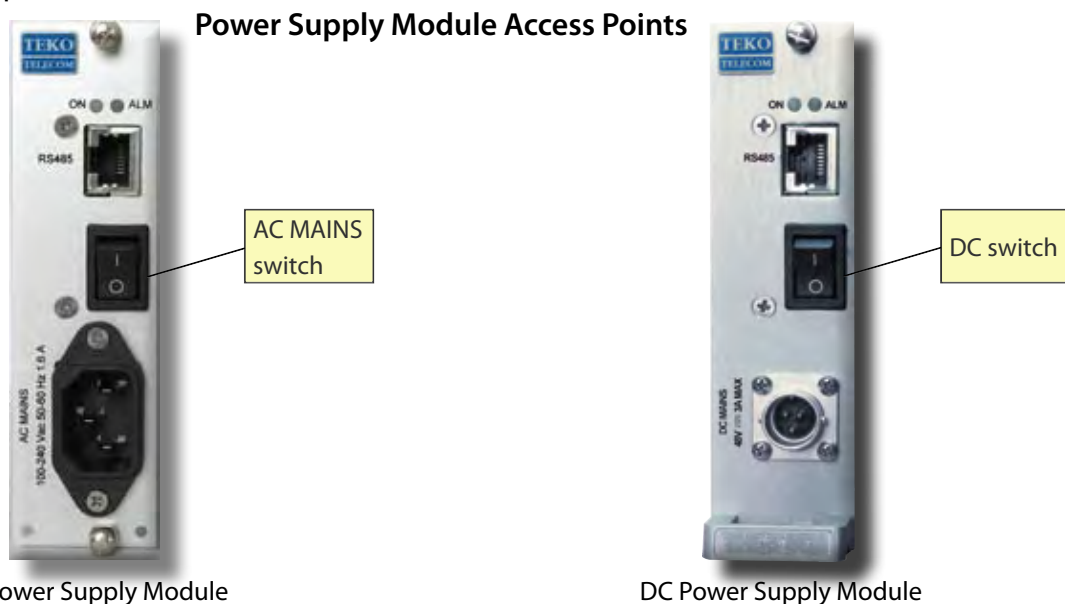

Fiber Optic Module equipped with 1 Transmitter split by 4 and 4 combined Receivers

Optical Connectors	Description
DL	Fiber Optic Transmitters (1 to 4) optical output SC-APC connectors
UL	Fiber Optic Receivers (1 to 4) optical power input SC-APC connectors

RF Connectors	Description
DL RF	Fiber Optic Transmitter RF input SMA connector
UL RF	Fiber Optic Receiver RF output SMA connector

LEDs	Description
ON	Fiber Optic Module operating status green LED ON when power supply is present
ALM	Fiber Optic Module alarm status LED: OFF: regular operation; BLINKING ORANGE/ORANGE: warning/minor; BLINKING RED/RED: major/critical
DL UL	These LEDs describe the general operating status of Remote Units (1 to 4) connected to Fiber Optic Transmitters (DL) and Repeaters (UL) . Each pair of DL/UL leds takes the same color as the general operating status led of the Remote Unit connected to the relevant optical connector, except when • a Laser Fault occurs in the Fiber Optic transmitter. If this fault occurs, all DL leds turn RED and the ALM Led switches on (RED). • a Low Optical Power alarm arises in the Fiber Optic receiver. If this alarm arises, the relevant UL led turns RED and the ALM Led switches on (RED). Each pair of DL/UL LEDs can be: Green: Remote Unit status OK Blinking Orange: presence of RU active alarms with **warning** severity level (4) Orange: presence of RU active alarms with **minor** severity level (3) Blinking Red: presence of RU active alarms with **major** severity level (2) Red: presence of RU active alarms with **critical** severity level (1)

- **Power Supply Module**

Power Supply modules are used to supply Optical Subracks. The modules can be equipped either in the Optical Subracks to be supplied or in the Master Optical Subrack. Hot-plug 1+1 Redundancy feature is supported: it can be implemented to achieve high system reliability.

As Optical Subracks can be AC powered (Universal mains, 85÷264Vac, 50-60Hz) or DC powered (-72 ÷ -36Vdc), they can be equipped with either AC or DC Power Supply modules.

When Power Supply modules are equipped in monitored Optical Subracks, the Power Supply Module RJ45 connector is used for connection to the Supervision Module, equipped in the Master Optical Subrack.
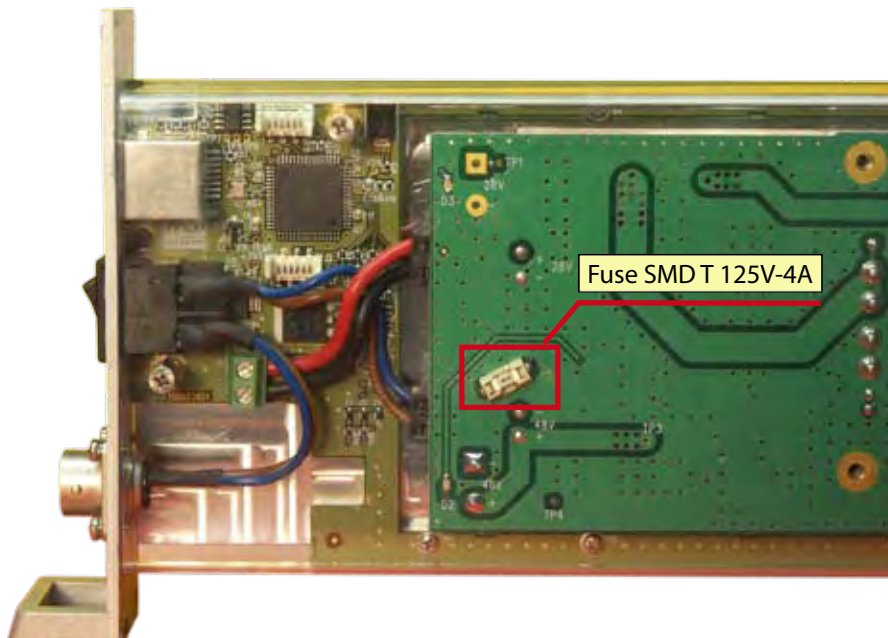
Power Supply Module Access Points

AC MAINS switch

DC switch

AC Power Supply Module   DC Power Supply Module

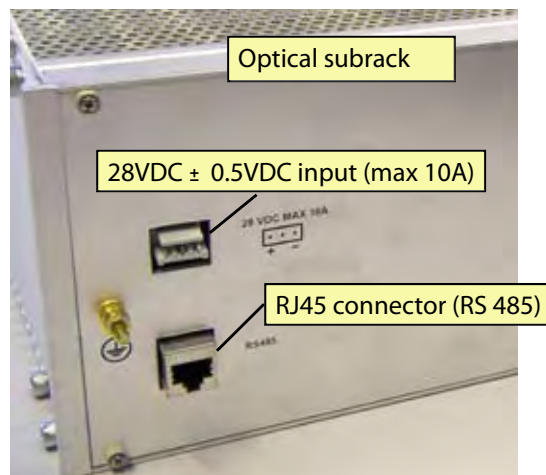| Connectors	Description
RS485	RJ45 connector for RS485 connection to the Supervision Module (monitored Subracks)
AC switch	AC MAINS switch
AC MAINS	AC MAINS socket (100-240Vac)

Connectors	Description
RS485	RJ45 connector for RS485 connection to the Supervision Module (monitored Subracks)
DC switch	48Vdc switch
DC MAINS	Vdc input connector (48Vdc)

LEDs	Description
POWER ON	Power Supply Module operating status green LED: ON when power supply is present
ALM	Power Supply Module alarm status LED. OFF: regular operation Blinking Orange: presence of active alarms with **warning** severity level (4) Orange: presence of active alarms with **minor** severity level (3) Blinking Red: presence of active alarms with **major** severity level (2) Red: presence of active alarms with **critical** severity level (1)

The following figure shows the DC/DC Power Supply Module protection fuse position and electrical rating. If the fuse blows, it has to be replaced.

Fuse SMD T 125V-4A

A 28Vdc input connector is available on the rear panel of each Optical Subrack to be used when power supply modules are not equipped in the Optical Subrack.

Optical subrack

28VDC ± 0.5VDC input (max 10A)

RJ45 connector (RS 485)

An RJ45 connector (RS485) is also available on the rear panel of each Optical Subrack to be used when power supply modules are not equipped in monitored Optical Subracks. It allows connection of monitored Optical Subracks to the Supervision Module.

• **Alarm Board Module**

The Alarm Board is an optional I/O MU Module which can be equipped in the Optical Subrack in addition to the Supervision Module, in order to increase the number of supported external alarms.

Up to 16 external alarms inputs can be managed with the Alarm Board: TEA-I16 Module has 16 external alarms input connectors available on its front panel.

Optionally, inputs 1-to-4 can be switched to dry output contacts, normally open or closed depending on HW configuration: TEA-I12O4 has 12 external alarms input connectors and 4 dry contacts outputs available on its front panel.

Alarm Board equipped with 16 input pins - TEA-I16

In TEA-I16, the 16 Input lines are opto-isolated and are activated by a short circuit between input pins (max current flow during short = 6mA; max Vcc at input pins = 3,3V).

In order to more handily connect to the 16 input dry contacts, four 2x4-pole female connectors are provided along with the Alarm Board Module.
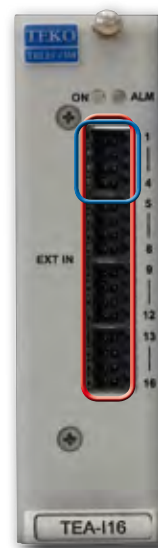

2x4-pole female connector

Alarm Board Module Access Points

Alarm Board Module
with female dry connectors

Alarm Board Module
without female dry connectors

Connectors	Description
EXT IN	External alarms input connector
EXT OUT	Optional external alarms output connector (TEA-I12O4)

LEDs	Information
ON	Alarm Board Module operating status green LED: ON when power supply is present
ALM	Alarm Board Module alarm status LED. OFF: regular operation Blinking Orange: presence of active alarms with **warning** severity level (4) Orange: presence of active alarms with **minor** severity level (3) Blinking Red: presence of active alarms with **major** severity level (2) Red: presence of active alarms with **critical** severity level (1)