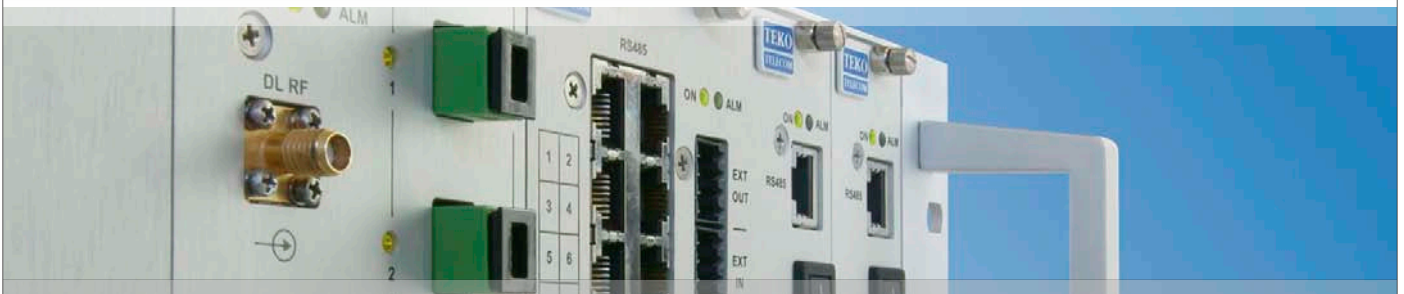


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SIRIUS: Teko Telecom Modular Coverage and Capacity System

General Description – Components and Solutions



SIRIUS: TECHNICAL HANDBOOK
Part A

Doc ID Number 91 080 0782 – Rel. 06

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Part

A

SIRIUS: Teko Telecom Modular Coverage and Capacity System

General Description – Components and Solutions



BOLOGNA, 14/05/2013

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Initial Notes

Declaration of Conformity (*)

According to Directive 1999/5/EC (R&TTE)

We TEKO TELECOM hereby declare that the products described in this technical handbook are manufactured by Teko Telecom S.r.l. *a Socio Unico*, Via Meucci, 24/a 40024 Castel S. Pietro Terme (Bologna) – ITALY. All the above cited products are compliant with the essential requirements of article 3 and other relevant provisions of the Radio & Telecommunications Terminal Equipment Directive, n.1999/5/EC, when used for their intended purpose: improving coverage of mobile communication networks.

Castel S. Pietro Terme (Bologna) – ITALY

Legal representative

Teko Telecom S.r.l.

a Socio Unico

(*) A signed copy of the conformity declaration is available upon request. Please get in touch with our after sale service, filling in the form on line at the following Internet address: www.tekotelecom.it

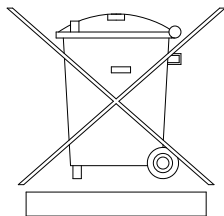
Note relevant to product utilization within the European Union (EU)

It's under user's own responsibility to verify to be compliant to the National provisions or authorisations required.

For further information refer to: http://ec.europa.eu/enterprise/sectors/rtte/index_en.htm

EU directive 2002/96/EC – WEEE (Waste Electrical and Electronic Equipment)

This product complies with the EU directive 2002/96/EC – WEEE (Waste Electrical and Electronic Equipment)



The symbol of the crossed container marked on the equipment shows that the product, at the end of its useful life, must be collected separately from other refuse. Therefore the user must deliver the equipment that has reached the end of its life to the special differentiated electronic and electrotechnical refuse collection centres, for subsequent dispatch of the discarded equipment for recycling, treatment and environmentally compatible disposal, thus contributing in preventing possible negative effects on the environment and on health and favouring the recycling of the materials from which the equipment is made.

Illicit disposal of the product by the user will lead to the application of the penalties provided for by the national legislations of the various Member States on receipt of directive 2002/96/EC.

For further information, please contact our after sales department: www.tekotelecom.it

Packaging and Packaging Waste Directive 94/62/EC

The packaging of the product complies with the Directive 94/62/EC, concerning packaging and packaging waste. Environmentally harmful materials are not used for packaging.

Packaging is made from materials that can easily be recycled after use. Depending on the means of transportation, the equipment is packed in a cardboard or wooden box, protected with expanded polystyrene or barrier bags.

The packaging materials are marked according to ISO 11 469.

Please do not throw packaging materials into unsorted waste but separate them according to local regulations waste disposal options.

Compliance with the Maximum Permissible Exposure (MPE) limits - Examples of minimum separation distance calculation, based on the EN 50385

The following table summarizes the results of the calculations carried out assuming:

- zero losses between the output connector of Teko Telecom equipment and the input connector of the antenna
- maximum gain estimated for outdoor Antenna $G_i = 19\text{dBi}$ (for each band)
- maximum gain estimated for indoor Antenna $G_i = 7\text{dBi}$ (for each band)
- no co-location or operation in conjunction with any other antenna or transmitter.

Please note

The following table is **not** meant to represent the actual compliance distance from a particular Teko Telecom Optical System or Modular Repeater, being antennas, cables, and other RF components not provided with Teko Telecom equipment.

The actual compliance distance from a particular equipment can be calculated in the final installation phase only - when antenna, cables and other RF components specifications are available.

Equipment	Type	Maximum Output Power	Minimum separation distance between a person and the antenna in order to comply with MPE limits [m]				
			Indoor installation		Outdoor installation		
			E=6 [V/m]	E=20 [V/m]	E=6 [V/m]	E=20 [V/m]	
Remote Unit and Service Front End (TSFE)	• Low Power Single band Remote Units • Medium Power EGSM band Remote Unit	29dBm	1.8	0.6	7.1	2.3	
	Medium Power DCS band Remote Unit	31dBm	2.2	0.7	8.9	2.8	
	• Low Power Dual band Remote Units • Medium Power UMTS band Remote Unit	32dBm	2.5	0.8	10.1	3.2	
	Triband Low Power Remote Units	33.8dBm	3.1	1.0	12.3	3.9	
	Dual band Medium Power Remote Units	34.6dBm	3.4	1.1	13.4	4.2	
	Low Power 4-band Remote Units	35dBm	3.6	1.1	14.2	4.5	
	Medium Power Triband Remote Units	35.6dBm	3.8	1.5	15.2	4.8	
	• Low Power 5-band Remote Units • High Power TETRA Remote Unit • High Power TETRA Service Front End	36dBm	4.0	1.3	15.9	5.0	
	• High Power Single band Remote Units (LTE800 or EGSM or DCS or UMTS) • High Power Service Front End (LTE800 or EGSM or DCS or UMTS or LTE2600)	40dBm	6.3	2.0	25.1	8.0	
	High Power Single band Remote Unit (LTE2600)	41dBm	7.1	2.2	28.1	8.9	
	• High Power Dual band Remote Units (LTE800 and/or EGSM and/or DCS and/or UMTS) • Very High Power Single band Remote Units • Very High Power Service Front End (LTE800 or EGSM or DCS or UMTS)	43dBm	8.9	2.8	35.6	11.2	
	High Power Dual Band Remote Units (LTE800 or EGSM or DCS or UMTS with LTE2600)	43.5dBm	9.5	3.0	37.7	11.9	
	High Power Tri Band Remote Units (LTE800 and/or EGSM and/or DCS and/or UMTS)	44.7dBm	10.9	3.5	43.6	13.8	
	High Power Tri Band Remote Units (LTE800 or EGSM or DCS or UMTS with LTE2600)	45.1dBm	11.4	3.6	45.3	14.3	
	Very High Power Dual Band Remote Units	46dBm	12.6	4.0	50.3	15.9	
	Very High Power Tri Band Remote Units	47.8dBm	15.5	4.9	61.6	19.5	
	Donor Front End (TDFE)	Single Band TETRA Donor Front End	21dBm	0.7	0.2	2.8	0.9
		Single Band EGSM Donor Front End	23dBm	0.9	0.3	3.6	1.1
		Single Band DCS Donor Front End	25dBm	1.1	0.4	4.5	1.4
		Single Band LTE 800 or LTE2600 Donor Front End	26dBm	1.3	0.4	5.0	1.6
Single Band UMTS Donor Front End		27dBm	1.4	0.5	5.6	1.8	



Operation is subject to the following conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The antenna(s) used for this transmitter must be installed to provide a separation distance of:

- at least 50cm for Low Power Remote Units family in Tri-Band system (with 8dB of maximum antenna gain for operating bands lower than 1.5GHz and 11dB for operating bands higher than 1.5GHz),
- at least 50cm for Low Power Remote Units family in Six-Band system (with 4.5dB of maximum antenna gain for operating bands lower than 1.5GHz and 6.5dB for operating bands higher than 1.5GHz),
- at least 50cm for Enhanced Power Remote Units family in Dual Band Public Safety system (with 7.89dB of maximum antenna gain for operating bands lower than 1.5GHz),
- at least 100cm for Enhanced Power Remote Units family in Six-Band system (with 16dB of maximum antenna gain for operating bands lower than 1.5GHz and 20dB for operating bands higher than 1.5GHz),
- at least 50cm for Donor Front End family (with 12.84dB of maximum antenna gain for operating bands lower than 1.5GHz and 19dB for operating bands higher than 1.5GHz),
- at least 150cm for Very High Power Amplifier radio module, equipped inside Service Front End family and Very High Power/Pole-mounting Remote Units family (with 8dB of maximum antenna gain for operating bands lower than 1.5GHz and 11.5dB for operating bands higher than 1.5GHz)

from all persons assuming no co-location or operating in conjunction with any other antenna or transmitter.

Specifications of antennas, cables, RF components, etc will be provided only in the final installation phase, being the external antenna not provided with equipment.

Equipment will be accessible only to maintenance men, that must switch it off before any maintenance operation.

WARNING. This is NOT a CONSUMER device.
It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS.
You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device.
Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

WARNING FOR COMMERCIAL BANDS:

- SMR700 Low (DL 728 ÷ 746MHz, UL 698 ÷ 716MHz)
- SMR700 High (DL 746 ÷ 756MHz, UL 777 ÷ 787 MHz)
- Commercial SMR800 (DL 862 ÷ 869MHz, UL 817 ÷ 824MHz)
- AMPS (DL 869 ÷ 894MHz, UL 824 ÷ 849MHz)
- SMR900 (DL 935 ÷ 941MHz, UL 896 ÷ 902MHz)
- PCS (DL 1930 ÷ 1995MHz, UL 1850 ÷ 1915MHz)
- PCSE (DL 1930 ÷ 2000MHz, UL 1850 ÷ 1920MHz)
- AWS (DL 2110 ÷ 2155MHz, UL 1710 ÷ 1755MHz)
- AWSE (DL 2110 ÷ 2180MHz, UL 1710 ÷ 1780MHz)
- WCS (DL 2350 ÷ 2360MHz, UL 2305 ÷ 2315MHz)

WARNING. This is NOT a CONSUMER device. This is a 90.219 Class B signal booster.
It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signal-boosters/registration.
Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

WARNING FOR PUBLIC SAFETY BANDS:

- Public Safety 700 (DL 763 ÷ 775MHz, UL 793 ÷ 805MHz)
- Public Safety 800 (DL 851 ÷ 862MHz, UL 806 ÷ 817MHz)
- Public Safety 900 (DL 935 ÷ 940MHz, UL 896 ÷ 901MHz)

Please note

- Fixed stations operating in the 1710-1755MHz band are limited to 1W EIRP and to a maximum antenna height of 10meters above ground
- Regarding to Public Safety bands, to be compliant with 90.217 d7), signal booster passbands are limited to the service band or bands for which the operator is authorized. In general, signal boosters should utilize the minimum passband that is sufficient to accomplish the purpose. When booster encompasses both commercial bands and public safety bands (SMR800/SMR900) has to be installed in DAS (Distributed Antenna system) indoor system.
- Regarding to Public Safety Bands, the output power capability of the Public Safety signal booster is designed for deployments providing a radiated power not exceeding 5W ERP for each retransmitted channel.

An example for Low/Enhanced Power and Very High Power Amplifier final installation is provided:

maximum radiated power: 5W ERP = 8.2W EIRP = 39dBm

For remote with splitter and more than one antenna:

$$G + P_{out} + A - 10 \log N \leq 39 \Rightarrow G \leq 39 - (P_{out} + A - 10 \log N)$$

with G = max gain (dBi), P_{out} = max signal booster output power (dBm), A = attenuation (dB), N = number of carriers



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Canada** **Industrie
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The Radio Standards Specification 102 (RSS-102) sets out the requirements and measurement techniques used to evaluate RF exposure compliance of radiocommunication apparatus designed to be used within the vicinity of the human body.

It is the responsibility of proponents and operators of antenna system installations to ensure that all radiocommunication and broadcasting installations comply at all times with Health Canada's Safety Code 6.

The antenna(s) used for this transmitter must be installed to provide a separation distance of:

- at least 50cm for Enhanced Power Remote Units family in Dual Band Public Safety system (with 11dB of maximum antenna gain for operating bands lower than 1.5GHz),
- at least 100cm for Enhanced Power Remote Units family in Six-Band system (with 16dB of maximum antenna gain for operating bands lower than 1.5GHz and 20dB for operating bands higher than 1.5GHz),
- at least 50cm for Donor Front End family (with 15.5dB of maximum antenna gain for operating bands lower than 1.5GHz and 19dB for operating bands higher than 1.5GHz),
- at least 150cm for Very High Power Amplifier radio module, equipped inside Service Front End family and Very High Power/Pole-mounting Remote Units family (with 8dB of maximum antenna gain for operating bands lower than 1.5GHz and 11.5dB for operating bands higher than 1.5GHz)

from all persons assuming no co-location or operating in conjunction with any other antenna or transmitter.

Specifications of antennas, cables, RF components, etc will be provided only in the final installation phase, being the external antenna not provided with equipment.

Equipment will be accessible only to maintenance men, that must switch it off before any maintenance operation.

La spécification sur les normes radioélectriques 102 (RSS-102) énonce les exigences et les techniques de mesure utilisées pour évaluer la conformité de l'exposition aux radiofréquences des appareils de radiocommunication conçus pour être utilisés à proximité du corps humain.

Il incombe aux promoteurs et exploitants d'installations de systèmes d'antennes de s'assurer que toutes les installations de radiocommunication et de radiodiffusion respectent tout le temps au code de sécurité 6 de santé du Canada.

La/les antenne (s) utilisée(s) pour ce transmetteur doit être installé afin de fournir une distance de séparation de:

- *Au moins 50 cm pour la famille des unités à distance améliorée en puissance dans le système à double bande de sécurité publique (avec 11dB de gain maximal d'antenne pour les bandes de service inférieures à 1,5 GHz),*
- *Au moins 100 cm pour la famille des unités à distance améliorée en puissance dans le système de six bandes (avec 16dB de gain maximal d'antenne pour les bandes inférieures à 1,5 GHz et 20dB pour les bandes supérieures à 1,5 GHz),*
- *Au moins 50 cm pour la famille de Front End Donateur (avec 15,5 dB de gain maximal d'antenne pour les bandes inférieures à 1,5 GHz et 19 dB pour les bandes supérieures à 1,5 GHz),*
- *Au moins 150 cm pour le module amplificateur radio à très haute puissance, équipé à l'intérieur de la famille de Front End de Service et la famille des unités à distance à très haute puissance/support de poteau (avec 8 dB of gain maximal pour les bandes inférieures à 1,5 GHz et 11 dB pour les bandes supérieures à 1,5 GHz)*

de toutes les personnes en supposant l'absence de colocalisation ou d'exploitation en conjonction avec une autre antenne ou émetteur.

Spécifications des antennes, câbles, composants à radiofréquence, etc. ne seront fournis que dans la phase finale de l'installation, étant que l'antenne externe n'est pas fourni avec l'équipement.

L'équipement sera accessible seulement aux hommes d'entretien, qui doit l'éteindre avant toutes les opérations de maintenance.

Frequency Band <i>Bande de fréquence</i>	Nominal Passband Gain <i>Gain dans la bande passante nominale</i>	Nominal Bandwidth <i>Largeur de bande nominale</i>	Rated mean output power (single carrier) <i>Puissance de sortie moyenne nominale (porteuse unique)</i>	Input and output impedances <i>Impédances d'entrée et de sortie</i>
Very High Power Amplifier Radio Module				
728-746MHz	48dB	18MHz	43dBm (20W)	50Ω
746-756MHz	48dB	10MHz	43dBm (20W)	50Ω
851-869MHz	48dB	18MHz	43dBm (20W)	50Ω
869-894MHz	48dB	25MHz	43dBm (20W)	50Ω
1930-1995MHz	48dB	65MHz	43dBm (20W)	50Ω
2110-2155MHz	48dB	45MHz	43dBm (20W)	50Ω
2620-2690MHz	48dB	70MHz	43dBm (20W)	50Ω
Digital Front End				
698-716MHz	64dB	18MHz	26dBm (0.4W)	50Ω
777-787 MHz	64dB	10MHz	26dBm (0.4W)	50Ω
806-824MHz	64dB	18MHz	26dBm (0.4W)	50Ω
824-849MHz	64dB	25MHz	26dBm (0.4W)	50Ω
1850-1915MHz	64dB	65MHz	26dBm (0.4W)	50Ω
1710-1755MHz	64dB	45MHz	26dBm (0.4W)	50Ω
2500-2570MHz	64dB	70MHz	26dBm (0.4W)	50Ω
798-806MHz	64dB	8MHz	26dBm (0.4W)	50Ω
Six-band Enhanced Power Remote Unit				
728-746MHz	36dB	18MHz	31dBm (1.25W)	50Ω
746-756MHz	36dB	10MHz	31dBm (1.25W)	50Ω
851-869MHz	36dB	18MHz	31dBm (1.25W)	50Ω
869-894MHz	36dB	25MHz	31dBm (1.25W)	50Ω
1930-1995MHz	36dB	65MHz	31dBm (1.25W)	50Ω
2110-2155MHz	36dB	45MHz	31dBm (1.25W)	50Ω
2110-2180MHz	36dB	70MHz	31dBm (1.25W)	50Ω
2350-2360MHz	36dB	10MHz	31dBm (1.25W)	50Ω
2620-2690MHz	36dB	70MHz	31dBm (1.25W)	50Ω
Dual-band Public Safety Enhanced Power Remote Unit				
768-776MHz	36dB	8MHz	31dBm (1.25W)	50Ω
851-869MHz	36dB	18MHz	31dBm (1.25W)	50Ω

The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.

La puissance de sortie nominale indiquée par le fabricant pour cet appareil concerne son fonctionnement avec porteuse unique. Pour des appareils avec porteuses multiples, on doit réduire la valeur nominale de 3,5dB, surtout si le signal de sortie est retransmis et qu'il peut causer du brouillage aux utilisateurs de bandes adjacentes. Une telle réduction doit porter sur la puissance d'entrée ou sur le gain, et ne doit pas se faire au moyen d'un atténuateur raccordé à la sortie du dispositif.

SIRIUS: Teko Telecom Coverage and Capacity Systems Technical Handbook 91 080 0782

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Part

A

SIRIUS: Teko Telecom Modular Coverage and Capacity System

General Description – Components and Solutions



Components

Part A. SIRIUS: General Description - Components and Systems

A1 Overview

Teko Telecom Coverage and Capacity Systems are flexible multi-carrier Systems that provide a wide range of wireless solutions to extend cellular coverage and to increase capacity in indoor and outdoor hot spots.

Modular design is a key feature of Teko Telecom Systems: it offers flexible configuration options to build the most suitable solution for any coverage need.

SIRIUS

Stand-alone Modular Repeaters, Optical Systems as well as integrated solutions share a unique common platform: SIRIUS.

SIRIUS includes a wide range of active and passive components that can be assembled in a variety of ways in order to provide easy to set-up, maintain, and upgrade products operating in the 380 to 2700MHz frequency range.

SIRIUS components can be used in different Systems with different functionalities to meet present needs and to allow system adaptation to changing conditions, always assuring optimized performances.

Teko Telecom Master Unit is the core of SIRIUS modular design: it is a versatile modular rack-based platform that controls the whole Coverage System and, depending on its components configuration, is able to provide:

- the RF interface towards the signal source (BTS, NodeB, e-NodeB, Repeater),
- the RF interface towards Service Antennas/leaky cable,
- the optical interface towards up to 144 Remote Units.

This technical handbook describes the components of SIRIUS and how these components can be assembled to provide Optical Systems and Modular Off-air Repeaters to improve coverage in different environments.

A2 Components

The components of SIRIUS can be grouped in the following categories:

1. Modules providing the RF interface towards the signal source

- **DAS Tray Point of Interface (TDTPOI) module:** is the single-band/single-operator interface used in Optical DAS Systems to directly (no external directional coupler nor load needed) interface up to 2 BTSs or NodeBs/e-NodeBs, either duplex or simplex, with or without diversity, SISO or MIMO 2x2.
- **Point of Interface (POI or TAPOI) module:** is the single-band/single-operator interface towards a BTS or NodeB/e-NodeB. The Point of Interface module is connected to the signal source via coaxial cable.
- **Digital Donor Front End Module:** is the single-band/single-operator interface towards a Donor Antenna, providing a connection to a BTS or NodeB/e-NodeB over an air link.

2. Equipment extending coverage / distributing capacity

- **Service Front End:** is the single-band/multi-operator interface towards a Service Antenna. It provides wireless signal to the area to be covered (Modular Repeaters). In Optical Systems the Service Front End can be used to extend coverage to the area close to the Master Unit site.
- **Remote Unit:** is the multi-carrier equipment used in Optical Systems to distribute wireless signal throughout the area to be covered (extensive areas coverage/active DAS).

3. Modules providing the optical interface towards Remote Units

- **Fiber Optic Transmitter/Receiver Modules** are the optical interface between Master Unit and Remote Units: they provide RF-to-Optical/Optical-to-RF conversion.
- **Master and Slave Point to Point Modules** perform the RF-to-Optical/Optical-to-RF conversion required by the optical point to point link connecting RF Interface modules to distant Fiber Optic Transmitter/Receiver Modules. The optical point to point link allows a separation distance -up to 20km- between RF Interface modules and Fiber Optic Transmitter/Receiver Modules.

4. Passive Modules providing distribution and filtering

Our passive components provide RF distribution and filtering.

The 2-way/4-way Combiner/Splitter can be used to manage up to 4 RF interface modules operating in the same band; several models of Triplexers -with or without built-in 1:4 Splitter/Combiner- are available to distribute signals operating over up to 3 different bands. The multiplexers distribute signals operating over multiple different bands - up to 5 (pentaplexer); up to 6 (esaplexer). Due to the flexible configuration options of Teko

Telecom Coverage and Capacity Systems, the same passive components can be used for different purposes.

- The **2-way/4-way Combiner/Splitter** can be used to manage either up to 4 RF interface modules, operating in the same band (Multi-Operator Systems) or up to 4 Fiber Optic Modules (Fiber Optic Transmitter/Receiver Modules or Master Point to Point Modules).
- The **Band Splitter/Combiner -Triplexer (with built-in 1:4 Splitter/Combiner)** can be used to manage up to 3 RF interface modules or Service Front End subracks, operating in different bands (and up to 4 Fiber Optic Modules). It can also manage up to 3 four-way splitter/combiner modules each connected to multiple RF interface modules, operating in the same band (and up to 4 Fiber Optic Modules).
- The **Pentaplexer (Esaplexer)** can be used to manage either up to 5 (6) RF interface modules operating in different bands or up to 5 (6) Service Front End subracks operating in different bands or up to 5 (6) four-way splitter/combiner modules- used to manage multiple RF interface modules (up to 4 for each band).

5. Modules for the management of the System

- The **Supervision Module** allows the management of the whole Coverage System.
- The **Alarm Module** is an optional module that can be equipped to increase the number of supported external alarms.

6. Power Supply Components

Our Power Supply Components include:

- AC/DC and DC/DC Power Supply modules, to be equipped inside Active subracks. Each module provides up to 100W output power; several modules can be connected in parallel to obtain the power required by the System (please refer to SIRIUS datasheet for details about derating factors).
- AC/DC and DC/DC space efficient Power Supply Subracks, providing up to 2.4kW (AC/DC) / 3kW (DC/DC) maximum output power in just one height unit space.
- A Power Supply distribution system for the remote powering of 48V_{DC} Low Power Remote Units.

The most suitable solution can be selected, according to the System total power consumption and to the installation requirements.

7. Subracks hosting the System modules

Both active and passive subracks are available.

- **Active subracks** are provided with a backplane that allows the management and power supply of active modules.

- **Passive subracks** are used to host passive modules that do not require power nor management to function. Passive Subracks allow a reduction in the cost of the whole system.

8. **Forced-air cooling Subrack**

A forced-air cooling subrack is available to ensure the air flow required for proper cabinet installed equipment operation.

Rack cabinets for hosting the System Subracks (indoor installation) and cabinets for Outdoor installation are also available.

A detailed description of Teko Telecom Modular Coverage and Capacity System components is provided in the following paragraphs.

A.2.1 Modules providing the RF interface towards the signal source

• DAS Tray Point of Interface (TDTPOI) modules

DAS Tray Point of Interface modules are used in Optical Systems to **directly** (no external directional coupler nor load needed) interface any kind of operator signal source: BTS or NodeB/e-NodeB, either duplex or simplex, with or without diversity, SISO or MIMO 2x2.

Two TDTPOI models are available:

- a single version (TDTPOI-x-S, x=operating band) for connection to one SISO BTS (with or without diversity),
- a dual version (TDTPOI-x-D, x=operating band) for connection either to two SISO BTSs (with or without diversity) or to one MIMO BTS.

TDTPOI are also equipped with software-controlled attenuators for Downlink and Uplink RF levels adjustment via the Coverage System Supervision Module and Management Tools.

RMS/Peak detectors and power limiter features enable monitoring of DL and UL signals. User-defined thresholds allow for alarms to be generated and protection to the DAS system from overpowering.

Optical Systems can be equipped with one DAS Tray or more to make multiple configurations available: single operator (single-band / multi-band) and multi-operator (single-band / multi-band).



TDTPOI-x-S
Single DAS Tray module

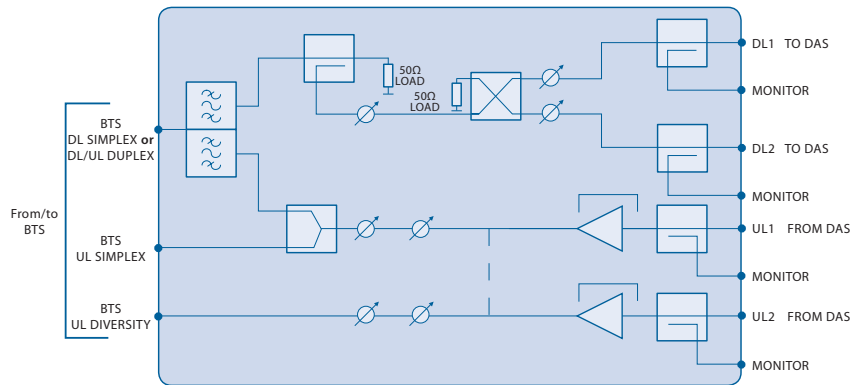


TDTPOI-x-D
Dual DAS Tray module

• SINGLE DAS Tray module (TDTPOI-x-S) - Access Points and Block diagram



SINGLE DAS Tray

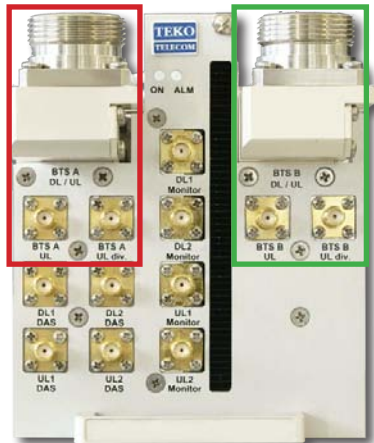


SINGLE DAS Tray Block diagram

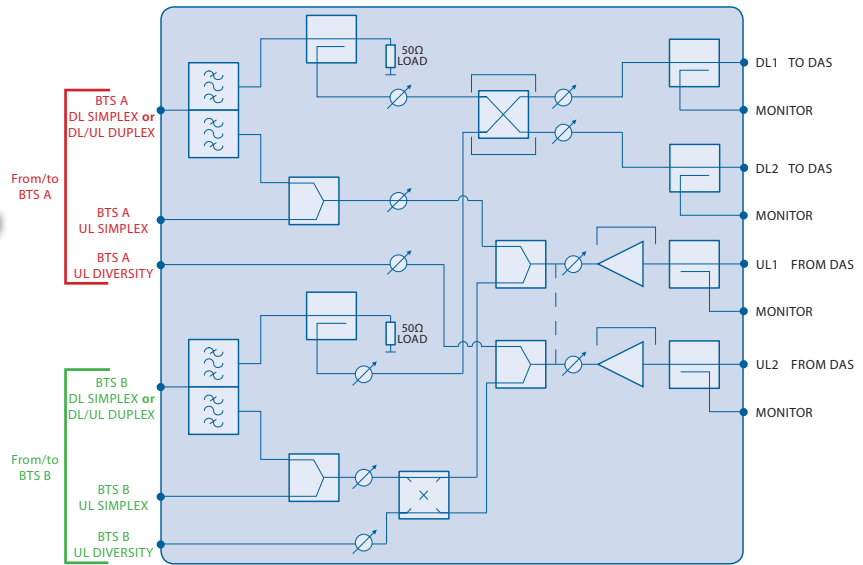
Label	BTS Type	Description
BTS A DL/UL	simplex	Simplex Downlink RF port 7/16(f) from BTS/NodeB/e-NodeB A
	duplex	Duplex port 7/16 (f) from (DL)/ to (UL) BTS/NodeB/e-NodeB A
BTS A UL	simplex	Simplex Uplink Output RF port (SMA-F) - to BTS/NodeB/e-NodeB A
BTS A UL div.	simplex/duplex with diversity	SMA(f) Uplink Diversity RF port - to BTS/NodeB/e-NodeB A (from UL2 DAS)
DL1 DAS	any	SMA(f) Downlink path RF output connector 1 (from BTS A)
DL1 Monitor	any	SMA(f) DL1 DAS Monitor port
DL2 DAS	any	SMA(f) Downlink path RF output connector 2 (from BTS A)
DL2 Monitor	any	SMA(f) DL2 DAS Monitor port
UL1 DAS	simplex	SMA(f) Uplink path RF input connector 1 (from DAS to BTS A UL)
	duplex	SMA(f) Uplink path RF input connector 1 (from DAS to BTS A DL/UL)
UL1 Monitor	any	SMA(f) UL1 DAS Monitor port
UL2 DAS	simplex	SMA(f) Uplink path RF input connector 2 (from DAS to BTS A UL)
	duplex	SMA(f) Uplink path RF input connector 2 (from DAS to BTS A DL/UL)
	simplex/duplex with diversity	SMA(f) Uplink path RF input connector 2 (from DAS to BTS A UL div.)
UL2 Monitor	any	SMA(f) UL2 DAS Monitor port
Led	Description	
ON	Module operating status green LED ON when power supply is present	
ALM	Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level	

• TDTPOI-x-D DAS Tray module Access Points and Block diagram - BTS simplex

Please refer to the TDTPOI-x-S Access Points for leds description



DUAL DAS Tray



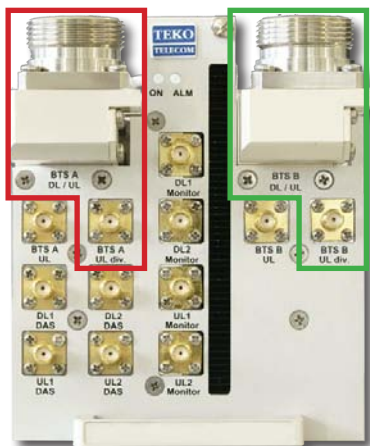
DUAL DAS Tray Block diagram

Access Points when the DUAL DAS TRAY is USED AS INTERFACE TOWARDS SIMPLEX BTS/ NodeB/e-NodeB (two SISO with or without diversity or one MIMO)

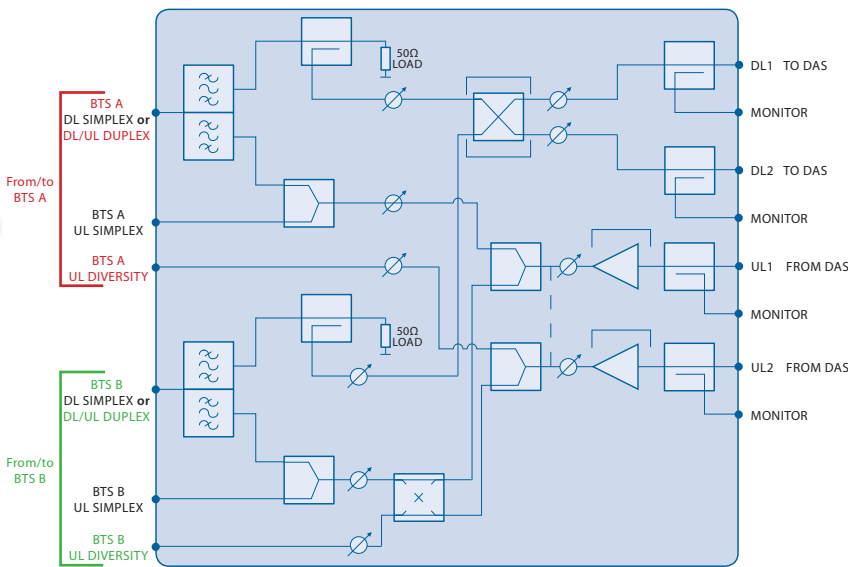
Label	Description
BTS A DL/UL	Simplex Downlink RF port (7/16-f) - from BTS/NodeB/e-NodeB A
BTS A UL	Simplex Uplink Output RF port (SMA-F) - to BTS/NodeB/e-NodeB A
BTS A UL div.	SMA(f) Uplink Diversity RF port - to BTS/NodeB/e-NodeB A (from UL2 DAS)
BTS B DL/UL	Simplex Downlink RF port from BTS/NodeB/e-NodeB B
BTS B UL	Simplex Uplink Output RF port (SMA-F) - to BTS/NodeB/e-NodeB B
BTS B UL div.	SMA(f) Uplink Diversity RF port - to BTS/NodeB/e-NodeB B (from UL2 DAS, UMTS diversity; from UL1 DAS, GSM diversity)
DL1 DAS	SMA(f) Downlink path RF output connector 1 (to DAS from BTS A separate paths, from BTS A+BTS B combined paths)
DL1 Monitor	SMA(f) DL1 DAS Monitor port
DL2 DAS	SMA(f) Downlink path RF output connector 2 (to DAS from BTS B separate paths, from BTS A+BTS B combined paths)
DL2 Monitor	SMA(f) DL2 DAS Monitor port
UL1 DAS	SMA(f) Uplink path RF input connector 1 from DAS to: BTS A UL (MIMO 2x2); BTS A UL + BTS B UL (Dual SISO and UMTS diversity); BTS A UL + BTS B UL diversity (GSM diversity)
UL1 Monitor	SMA(f) UL1 DAS Monitor port
UL2 DAS	SMA(f) Uplink path RF input connector 1 to: BTS B UL (MIMO 2x2); BTS A UL + BTS B UL (Dual SISO); BTS A UL diversity + BTS B UL diversity (UMTS diversity); BTS A UL diversity + BTS B UL (GSM diversity)
UL2 Monitor	SMA(f) UL2 DAS Monitor port

• TDTPOI-x-D DAS Tray module Access Points and Block diagram - BTS duplex

Please refer to the TDTPOI-x-S Access Points for leds description



DUAL DAS Tray



DUAL DAS Tray Block diagram

Access Points when the DUAL DAS TRAY is USED AS INTERFACE TOWARDS DUPLEX BTS (two SISO BTSs with or without diversity or one MIMO BTS)

Label	Description
BTS A DL/UL	Duplex port (7/16-f) from (DL) /to (UL) BTS/NodeB/e-NodeB A
BTS A UL div.	SMA(f) Uplink Diversity RF port - to BTS/NodeB/e-NodeB A (from UL2 DAS)
BTS B DL/UL	Duplex port (7/16-f) from (DL) /to (UL) BTS/NodeB/e-NodeB B
BTS B UL div.	SMA(f) Uplink Diversity RF port - to BTS/NodeB/e-NodeB B (from UL2 DAS, UMTS diversity; from UL1 DAS, GSM diversity)
DL1 DAS	SMA(f) Downlink path RF output connector 1 (from BTS A separate paths, from BTS A+BTS B combined paths)
DL1 Monitor	SMA(f) DL1 DAS Monitor port
DL2 DAS	SMA(f) Downlink path RF output connector 2 (from BTS B separate paths, from BTS A+BTS B combined paths)
DL2 Monitor	SMA(f) DL2 DAS Monitor port
UL1 DAS	SMA(f) Uplink path RF input connector 1 to: BTS A DL/UL (MIMO 2x2); BTS A DL/UL + BTS B DL/UL (Dual SISO and UMTS diversity); BTS A DL/UL + BTS B UL diversity (GSM diversity)
UL1 Monitor	SMA(f) UL1 DAS Monitor port
UL2 DAS	SMA(f) Uplink path RF input connector 1 to: BTS B DL/UL (MIMO 2x2); BTS A DL/UL + BTS B DL/UL (Dual SISO); BTS A UL diversity + BTS B UL diversity (UMTS diversity); BTS A UL diversity + BTS B DL/UL (GSM diversity)
UL2 Monitor	SMA(f) UL2 DAS Monitor port

- **Point Of Interface Modules**

Point of Interface modules are used in Optical Systems to interface any kind of operator signal source - BTS or NodeB/e-NodeB: each Point of Interface module is connected to a single mobile operator/ mobile band signal source via coaxial cable.

Optical Systems 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).



Passive Point Of Interface module (POI)
with rotary adjustable attenuators



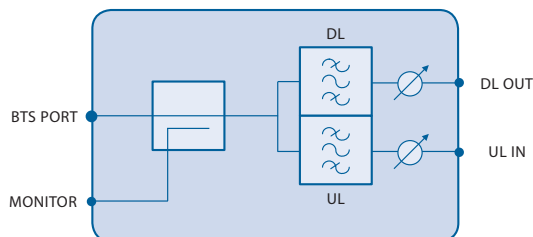
Point Of Interface module (TAPOI) with
remote-controlled variable attenuators

Teko Telecom Point of Interface modules can be equipped either with manually adjustable attenuators (POI-x models) or with remote-controlled attenuators (TAPOI-x models).

POI modules

Each POI module includes the duplexer, to separate/combine Downlink and Uplink paths and two rotary adjustable attenuators to make both Downlink and Uplink RF levels separately adjustable, within a range of either 30dB, with 1dB step, or 10dB, with 1dB step (POI-A10 models).

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

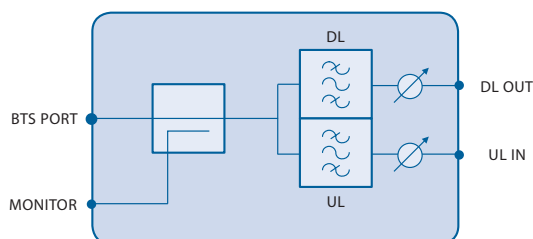


Point Of Interface module block diagram

TAPOI modules

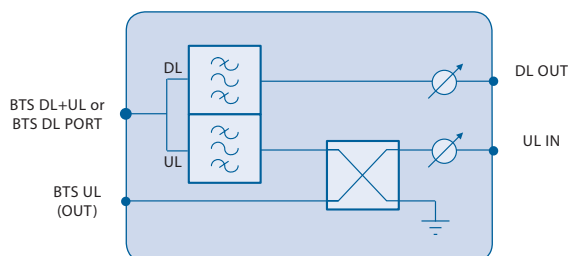
Several models of TAPOI modules are available:

- Duplex TAPOI (Commercial code: TAPOI-band): include the duplexer, to separate/combine Downlink and Uplink paths and two automated variable attenuators to adjust Downlink and Uplink RF levels via the Coverage System Supervision Module (TSPV) and Management Tools (OMT webpages, OMC software). Duplex TAPOI modules make a monitor port available (measurements/external wireless modem coupling).



Duplex TAPOI - Block diagram

- Simplex TAPOI (Commercial code: TAPOI-band code-TRX): TAPOI modules without built-in duplexer provide separate Downlink and Uplink ports.
- Flexible TAPOI (Commercial code: TAPOI-band code-F)
Flexible TAPOI can operate either as duplex or simplex TAPOI modules: they include both a BTS duplex port (N type) and a simplex Uplink BTS port (BTS UL, SMA type).



Flexible TAPOI - Block diagram

• POI Modules Access Points



Passive POI with built-in duplexer



Passive POI without built-in duplexer

Label (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/e-Node B or repeater)
MONITOR	Monitor port for measurements or for external wireless modem coupling

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

• TAPOI Modules Access Points



Duplex TAPOI



Flexi TAPOI



Simplex TAPOI

TAPOI model	Label	Description
Duplex	BTS PORT	Duplex port from/to BTS/NodeB/e-NodeB/repeater (N type)
Flexi	BTS DL/UL	Duplex port from /to BTS/NodeB/e-NodeB/repeater (N type) or Downlink RF port (N type) from BTS/NodeB/e-NodeB/repeater
Simplex	BTS DL	Input RF port (N type) from BTS/NodeB/e-NodeB/repeater
Duplex	MONITOR	Monitor port for either measurements or external wireless modem coupling
Flexi Simplex	BTS UL	Output RF port (SMA type) - to BTS/NodeB/e-NodeB/repeater
Duplex/Flexi Simplex	DL OUT	Downlink path RF output connector (SMA type)
Duplex/Flexi Simplex	UL IN	Uplink path RF input connector (SMA type)
Duplex/Flexi Simplex	ON	TAPOI Module operating status green LED ON when power supply is present
Duplex/Flexi Simplex	ALM	TAPOI Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

- **Teko Telecom Digital Donor Front End (TDFE)**

The Digital Donor Front End Module is the single-band/single-operator System RF interface towards a Donor Antenna, providing Downlink digital filtering and Uplink Power Amplifier. No physical connections are required between the DFE and the cellular network: the Donor Antenna provides the connection to a BTS or NodeB/e-NodeB over an air link.

Coverage Systems can be equipped with one or more Donor Front End modules to make multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).



A single-band single-operator modular Off-air Repeater can be set up combining a Digital Donor Front End Module and a Service Front End (Teko Telecom single-band/multi-operator interface towards a Service Antenna). Up to 4 Donor Front End Modules can be connected to a single Service Front End to provide a single-band 4-operator modular Off-air Repeater.

Digital Donor Front End Modules can also be used to drive Optical Systems: the Digital Donor Front End Module allows Optical Systems to be driven without the need of a dedicated BTS or NodeB/e-NodeB. A donor antenna picks-up the signal and the Optical System acts as a repeater with distributed Service antennas connected to the Remote Units. Service Front End subracks can be connected to DFE modules to provide coverage to the area next to the Master Unit site.

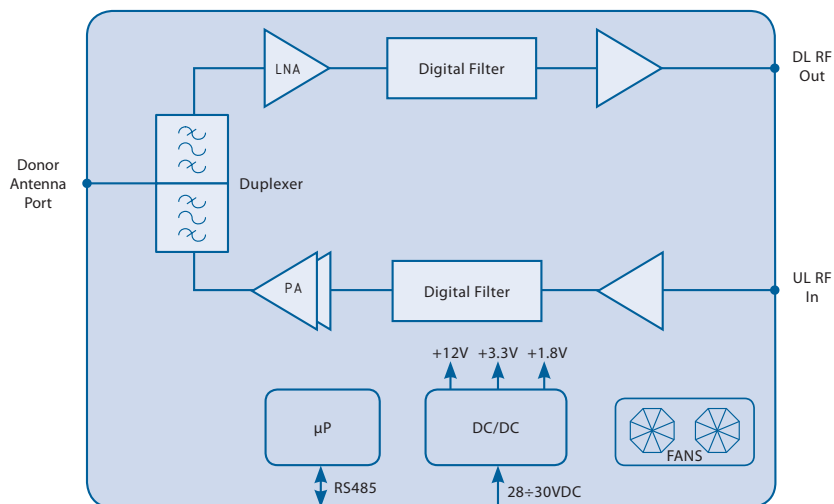
Each DFE module hosts the duplexer, to be connected to the Donor Antenna to separate/combine downlink and uplink paths.

In downlink the signal from the Donor Antenna is preamplified by a Low Noise Amplifier and converted into an IF signal by a down converter. The selection of the band of frequencies or channels to be extended is handled by a digital filter.

The digital filter can manage 1 variable band or 2 variable sub-bands (standard version). A fully equipped version is available to manage up to 9 variable sub-bands.

An up converter converts the IF signal into the RF output signal.

In uplink the signal from the Service Front End Subrack or from the Optical System is converted into an IF signal by a down converter, filtered and re-converted into an RF signal, amplified by a power amplifier and re-transmitted to the signal source.



Digital Donor Front End Module block diagram

Digital Donor Front End Module Access Points



Label (Connectors)	Description
DL	Downlink path RF output (SMA connector) to Service Front End or Fiber Optic Modules
UL	Uplink path RF input (SMA connector) from Service Front End or Fiber Optic Modules
DONOR ANT	Donor Antenna Port (N type connector)

Label (LEDs)	Description
ON	Digital Donor Front End Module operating status green LED: ON when power supply is present
ALM	Digital Donor Front End Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

A.2.2 Equipment extending coverage / distributing capacity

• Teko Telecom Service Front End (TSFE)

Teko Telecom Service Front End is a single-band/multi-operator equipment, driven by Digital Donor Front End Modules and connected to the Service Antenna/Leaky Cable to provide wireless signal to the area to be covered. The equipment is available in four different power classes: Very High, High, Medium and Low.

A single-band single-operator modular Off-air Repeater can be set-up combining a Digital Donor Front End Module and a Service Front End. Up to 4 Donor Front End Modules can be connected to a single Service Front End subrack to provide a single-band 4-operator Repeater.

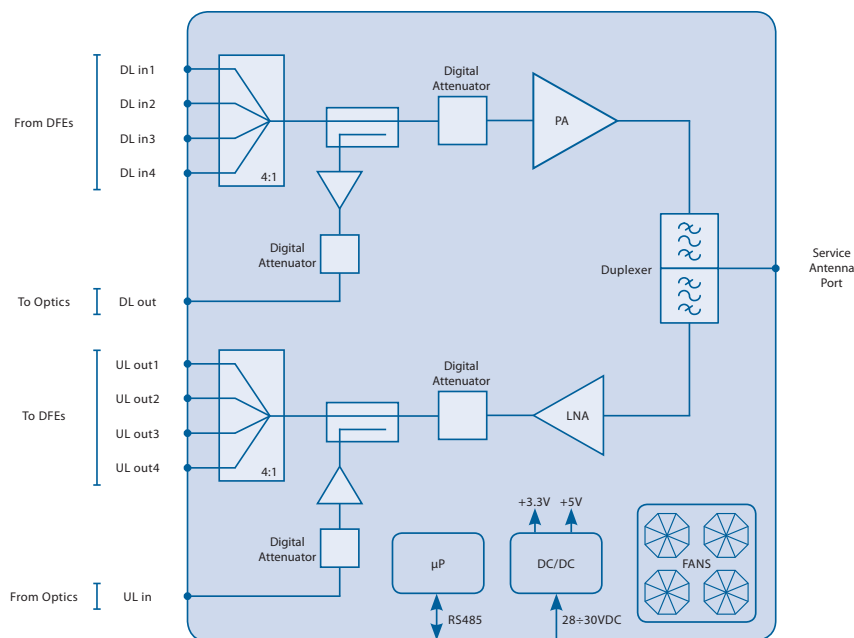
The Service Front End subrack can also be used in Optical Systems to provide coverage to the area adjoining the Master Unit site.

The TSFE 19"/2U subrack hosts the duplexer, to be connected to the Service Antenna to separate/combine Downlink and Uplink paths.

In Downlink the signals from the Donor Front-End Modules are combined and amplified by a Power Amplifier.

In Uplink, the RF signal from the Service antenna is amplified by a Low Noise Amplifier (LNA) and split to feed up to 4 Donor Front-End Modules.

Auxiliary ports are available to drive an Optical System.



Service Front End block diagram

Service Front End Access Points



Label (Connectors)		Description
DL TO OPT		Downlink path RF output (SMA connector) - to Optics
UL FROM OPT		Uplink path RF input (SMA connector) - from Optics
SERVICE ANT		Service Antenna Port (N type)
DFE1	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 1
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 1
DFE2	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 2
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 2
DFE3	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 3
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 3
DFE4	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 4
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 4

Label (LEDs)	Description
LED	<p>Service Front End subrack general operating status LED</p> <p>Green: no alarm</p> <p>Blinking Orange: presence of active alarms with warning severity level</p> <p>Orange: presence of active alarms with minor severity level</p> <p>Blinking Red: presence of active alarms with major severity level</p> <p>Red: presence of active alarms with critical severity level</p>

• **Teko Telecom Remote Units**

Remote Units are used in Optical Systems to distribute wireless signals throughout the area to be covered. They are connected to the Fiber Optic Transmitter/Receiver Modules equipped in the Master Unit.

Remote Units are equipped with the Fiber Optic Receiver and Transmitter module (for Optical to RF and RF to Optical conversion), power amplifiers and filtering.

They can be Single band or Multi-band with four different RF power classes: Very High, High, Medium and Low.

Remote Units with different power classes can be driven simultaneously by the same Master Unit to distribute capacity or extend coverage into different locations at the same time.

Very High, High and Medium Power Remote Units are equipped in a weatherproof IP66 rating case. Low Power Remote Units are equipped in an IP32 case; a protection kit, providing IP66 rating, is available as option for harsh environment installation.

The pole-mounting Remote Unit mechanical design allows the Unit to be mounted inside utility poles with 12" internal radius.



Pole-mounting Remote Unit



Very High, High and Medium Power Remote Units



Low Power Remote Units

Please refer to page A71 for a detailed description of Remote Units.

A.2.3 Modules providing the optical interface towards Remote Units

• Fiber Optic Transmitter/Receiver Modules

Fiber Optic Transmitter/Receiver Modules are the optical interface between Master Unit and Remote Units: they 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 a single strand of fiber (Wavelength Division Multiplexing -WDM technology).

Different 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 12km distance - 7.5 miles).

The Fiber Optic Transmitter/Receiver Module in 1:4 configuration can manage up to 4 Remote Units.

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



Fiber Optic Transmitter/Receiver Module in 1:4 configuration



Fiber Optic Transmitter/Receiver Module (1:4 configuration) with monitor for E9-1-1 service

The Fiber Optic Transmitter provides the RF to optical conversion (Downlink side): the module RF section covers the 380 to 2700MHz band (TTRU models).

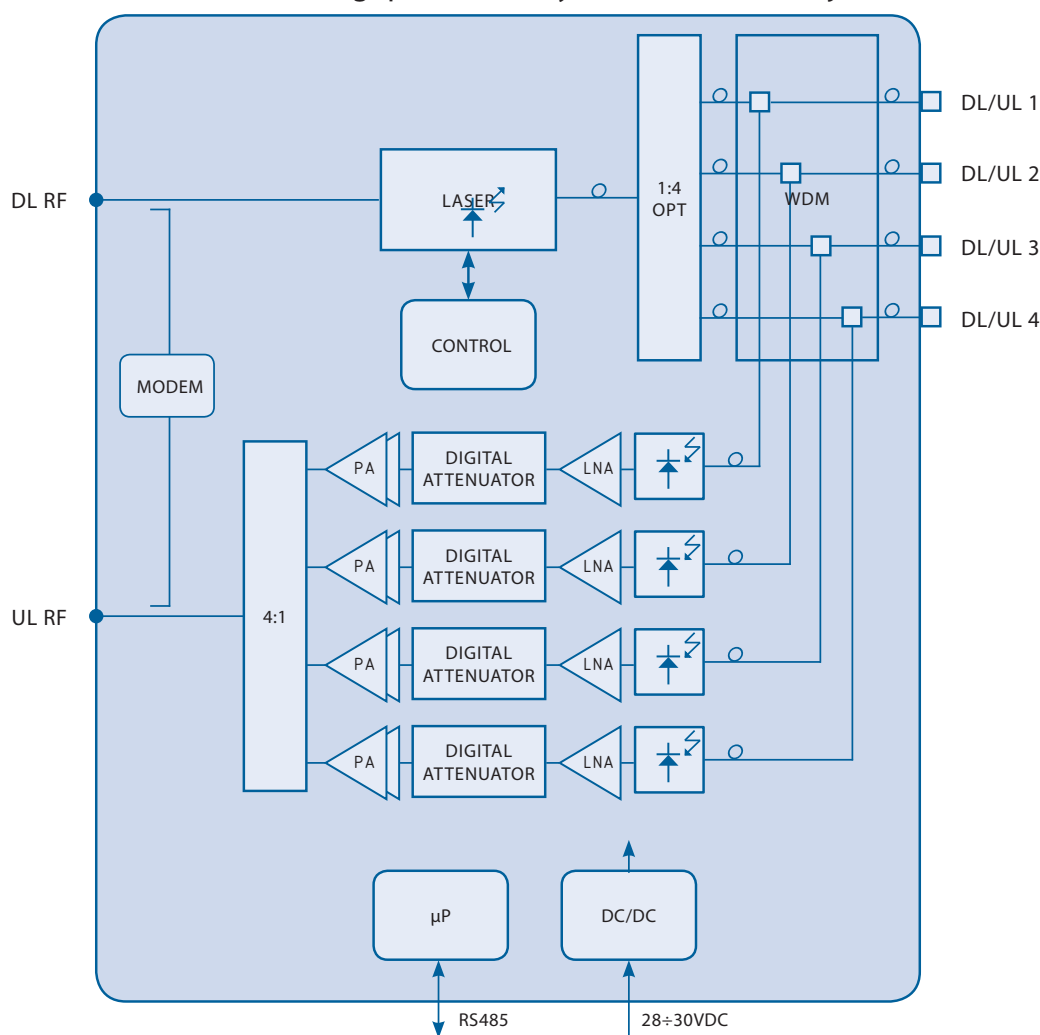
Fiber Optic Receivers convert uplink optical signals from Remote Units into RF. They operate

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:

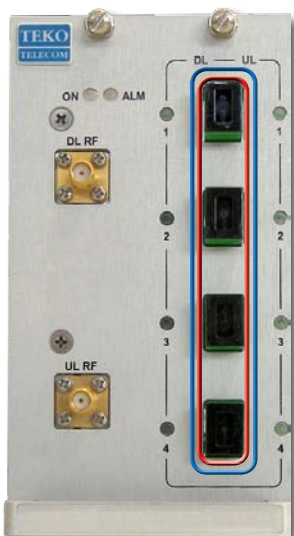
- optical power received by each optical receiver,
- Downlink attenuator and Uplink attenuator attenuation setting (0 ÷ 15dB),
- received optical power alarms.

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.

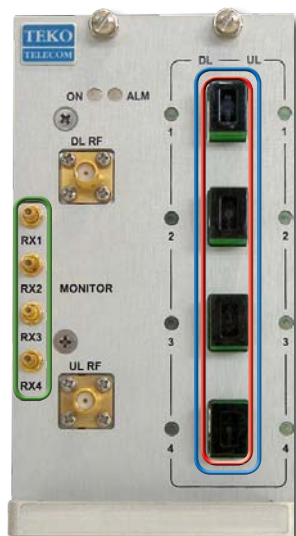


Block diagram: Fiber Optic Transmitter/Receiver Module equipped with 1 Optical Transmitter split by 4 and 4 combined Optical Receivers (WDM technology)

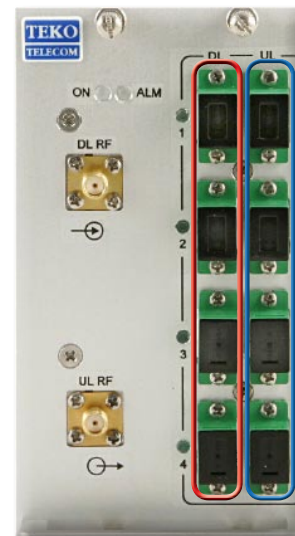
Fiber Optic Transmitter/Receiver Module Access Points



Fiber Optic Module 1:4 configuration - WDM



Fiber Optic Module 1:4 configuration - WDM with Monitor for E9-1-1 service



Fiber Optic Module 1:4 configuration

Label (Connectors)	Description
DL (1 to 4)	Fiber Optic Transmitters optical output connectors (SC-APC)-laser aperture
UL (1 to 4)	Fiber Optic Receivers optical input connectors (SC-APC)
DL RF	Fiber Optic Transmitter RF input SMA connector
UL RF	Fiber Optic Receiver RF output SMA connector
Monitor RXn	Remote Units Monitor ports (1 to 4) for E 9-1-1 service - SSMB (m) connectors

Label (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	<p>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 optical connector, except when</p> <ul style="list-style-type: none"> • 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 UL led turns RED and the ALM Led switches on (RED). <p>Each pair of DL/UL LEDs can be:</p> <ul style="list-style-type: none"> Green: Remote Unit status OK Blinking Orange: presence of RU active alarms with warning severity level Orange: presence of RU active alarms with minor severity level Blinking Red: presence of RU active alarms with major severity level Red: presence of RU active alarms with critical severity level

- **Master and Slave Point to Point Modules**

Master and Slave Point to Point Modules provide an optical point to point link allowing a separation distance -up to 20km- between RF interface subracks and slave optical subracks.

The point to point link is suitable when the signal source (BTS, NodeB/e-NodeB, Repeater) is located far from the area to be covered or when the same optical system provides coverage to several separate buildings; in these applications the point to point link allows the transmission of signals from/to a group of remote units over a single strand of optical fiber, thus providing a significant reduction in the number of fiber optics running long distances.

The point to point link requires the RF interface subracks to be equipped with Master Point to Point modules and the remote (slave) optical subracks to be equipped with Slave Point to Point modules. The RF Interface subracks can be equipped with up to 4 Master Point to Point modules for the management of up to 4 optical subracks, installed in different remote locations.



Master Point to Point Module

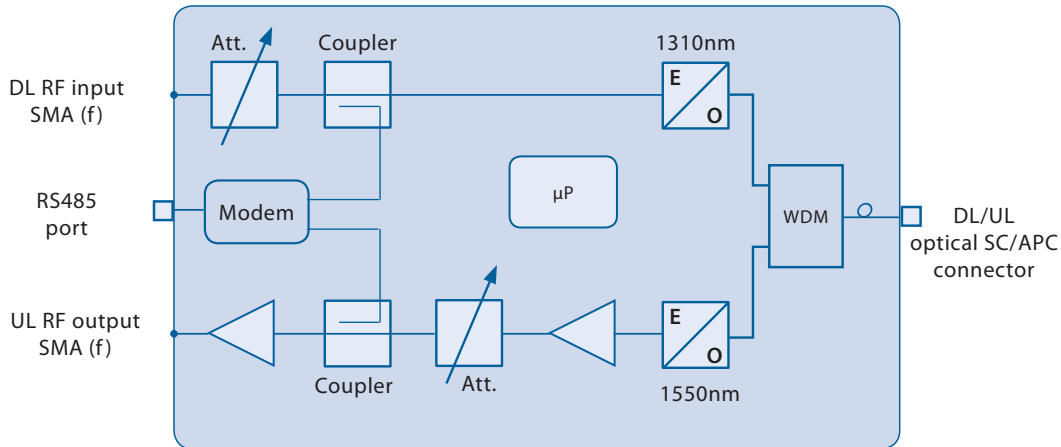


Slave Point to Point Module

Master and Slave Point to Point Modules are connected via a single optical fiber (single-mode SMR 9/125).

Each Slave optical subrack can be equipped with up to 3 Slave Point to Point Modules for the coverage of up to 3 sectors.

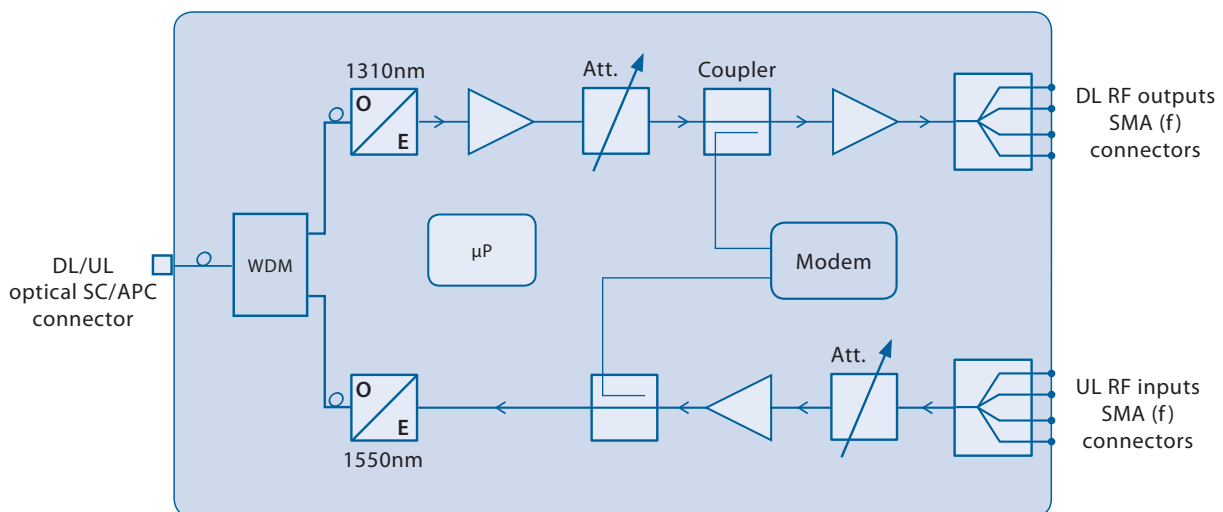
Point to Point Modules (Master and Slave) perform the electrical-to-optical/optical-to-electrical conversion required for the transmission of downlink and uplink signals over the connecting optical fiber.



Master Point to Point Module block diagram

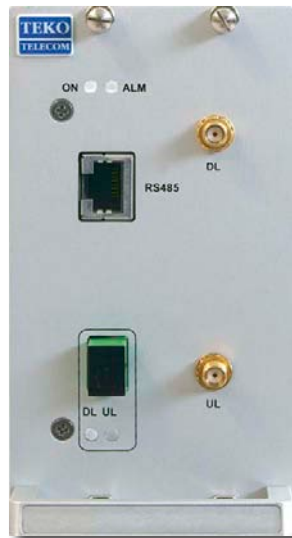
The Slave Point to Point module includes the 4-way splitter/combiner to manage up to 4 Fiber Optic Transmitter/Receiver Modules. A built-in Supervision unit controls the Slave optical subrack, hosting the Slave Point to Point module, and all connected Remote Units.

The Coverage System Supervision Module communicates with the Slave Point to Point module built-in Supervision unit via the single-mode optical fiber connecting Master and Slave Point to Point modules. When Remote optical subracks are equipped with 2 or 3 Slave Point to Point Modules, only one module communicates with the System Supervision module.



Slave Point to Point Module block diagram

Master Point to Point Module Access Points

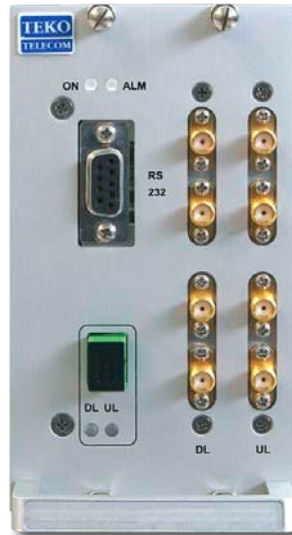


Master Point to Point Module

Label (Connectors)	Description
DL UL	Optical input/output SC-APC connector (from/to Slave Point to Point Module) - laser aperture
RS485	RJ45 connector for RS485 connection to the Supervision Module
DL	RF input SMA connector (from the System RF Interface modules)
UL	RF output SMA connector (to the System RF Interface modules)

Label (LEDs)	Description
ON	Master Point to Point Module operating status green LED: ON when power supply is present
ALM	Point to Point Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level
DL	Fiber Optic Transmitter operating status LED: BLINKING GREEN: the module is reaching its operating temperature GREEN optical output power is available ORANGE: warning: optical output power is degraded RED: Laser Fault: no optical output power
UL	Fiber Optic Receiver operating status LED: GREEN: +6dBm to -5dBm optical input power When a Low Optical Power alarm arises in the Fiber Optic receiver the UL led turns RED and the ALM Led switches on (RED)

Slave Point to Point Module Access Points



Slave Point to Point Module

Label (Connectors)	Description
DL UL	Optical input/output SC-APC connector (from/to Master Point to Point Module) - laser aperture
RS232	Factory use only
DL	RF output SMA connectors (to Fiber Optic Modules)
UL	RF input SMA connectors (from Fiber Optic Modules)
Label (LEDs)	Description
ON	Master Point to Point Module operating status green LED: ON when power supply is present
ALM	Point to Point Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level
DL	Fiber Optic Receiver operating status LED: GREEN: +6dBm to -5dBm optical input power When a Low Optical Power alarm arises in the Fiber Optic receiver the DL led turns RED and the ALM Led switches on (RED)
UL	Fiber Optic Transmitter operating status LED: BLINKING GREEN: the module is reaching its operating temperature GREEN optical output power is available ORANGE: warning: optical output power is degraded RED: Laser Fault: no optical output power

A.2.4 Passive Modules providing distribution and filtering

- **Combiner/Splitter Modules**

Combiner/Splitter Modules can be used to manage either up to 4 RF interface modules (POI modules or TDFE modules), operating in the same band (Multi-Operator Systems) or up to 4 Fiber Optic Transmitter/Receiver Modules.

2-way and 4-way Combiner/Splitter modules are available.

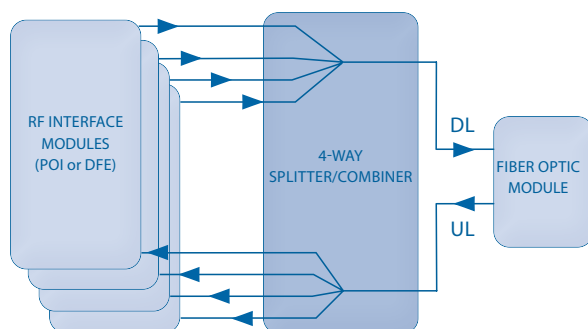


2-way Combiner/Splitter

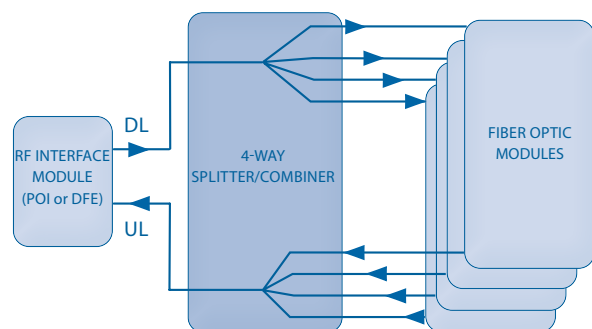


4-way Combiner/Splitter

Example: 4-way Combiner/Splitter module block diagrams

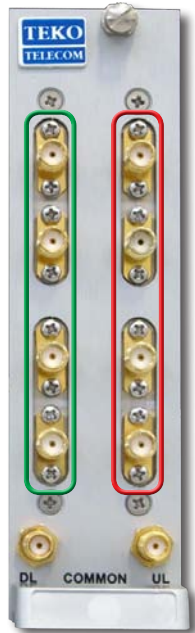


4-way combiner (DL side) / 4-way splitter (UL side) to manage up to 4 RF interface modules operating in the same band



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

Combiner/Splitter Modules Access Points



4-way Combiner/Splitter



2-way Combiner/Splitter

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

- **Triplexer (Band Splitter/Combiner)**

The Triplexer is used in multi-band configurations to distribute signals operating over different bands. Several models of Triplexers, operating over different Uplink/Downlink frequency bands, are available. The triplexer can be equipped with a built-in 4-way Splitter/Combiner.



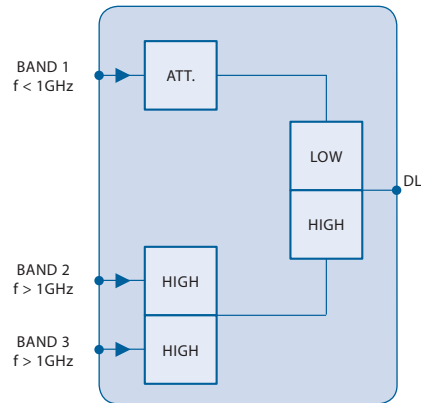
Triplexer without built-in 4-way Combiner/Splitter



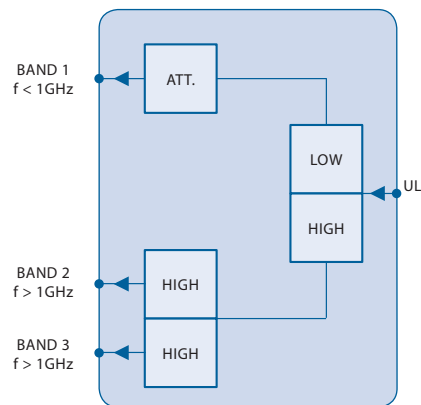
Triplexer with built-in 4-way Combiner/Splitter

The triplexer (with built-in 4-way Splitter/Combiner) can be used in Optical Systems to manage:

- up to 3 RF interface modules operating in different bands (and up to 4 Fiber Optic Transmitter/Receiver Modules), or
- up to 3 Service Front End 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 RF interface modules- up to 4 for each band (and up to 4 Fiber Optic Transmitter/Receiver Modules).



Example: 1-Low-band + 2-High-Band Triplexer block diagram
Downlink path

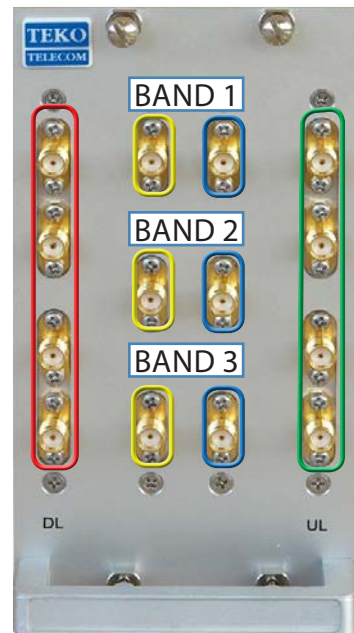


Example: 1-Low-band + 2-High-Band Triplexer block diagram
Uplink path

Triplexer Module Access Points -Example



Triplexer without built-in 4-way Combiner/Splitter



Triplexer with built-in 4-way Combiner/Splitter

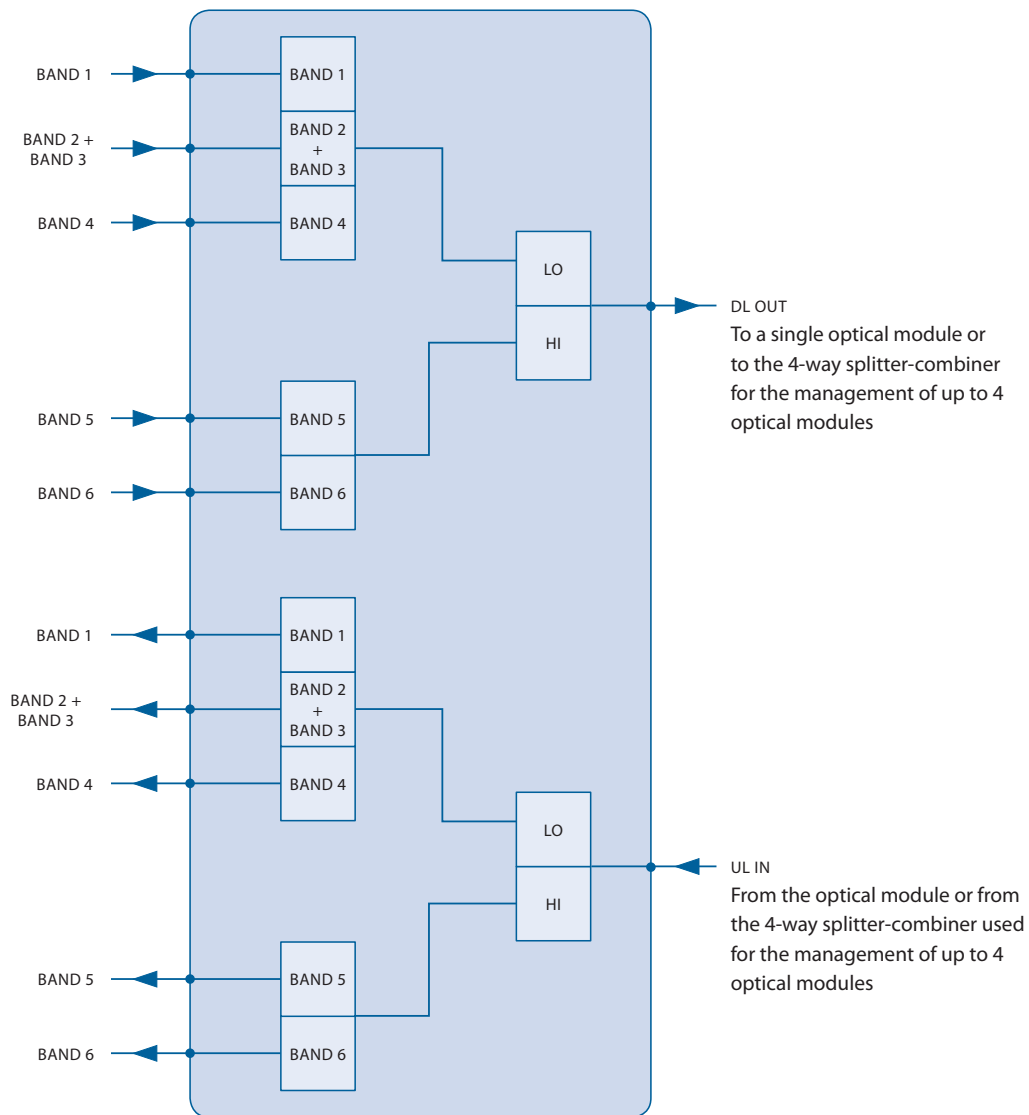
Connectors	Description
BAND 1	BAND 1 input (down-link path)
	BAND 1 output (up-link path)
BAND 2	BAND 2 input (down-link path)
	BAND 2 output (up-link path)
BAND 3	BAND 3 input (down-link path)
	BAND 3 output (up-link path)

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

• **Esaplexer (US bands)**

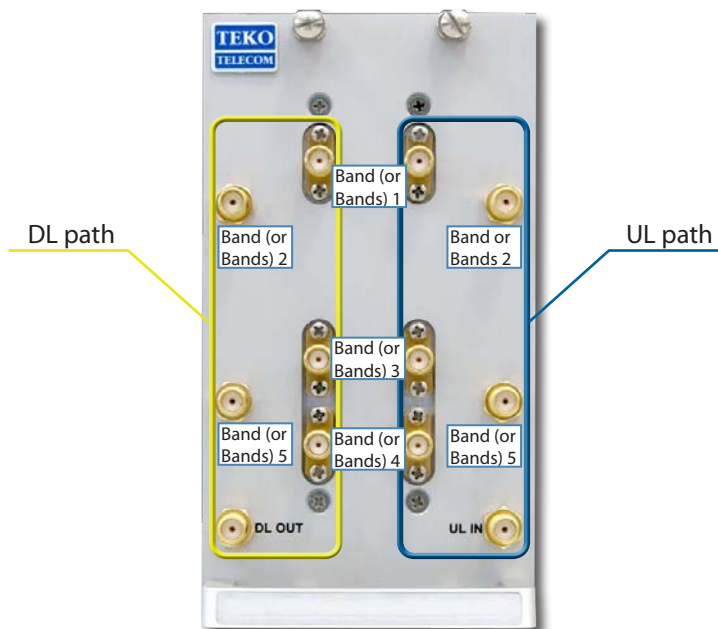
The Esaplexer is used in multi-band configurations to distribute signals operating over up to 6 different bands.

The Esaplexer can be connected to a 4-way splitter/combiner in order to manage up to 4 Fiber Optic Transmitter/Receiver Modules (i.e. up to 16 Remote Units).



Example: 4-Low-band + 2-High-Band Esaplexer block diagram

• Esaplexer Access Points

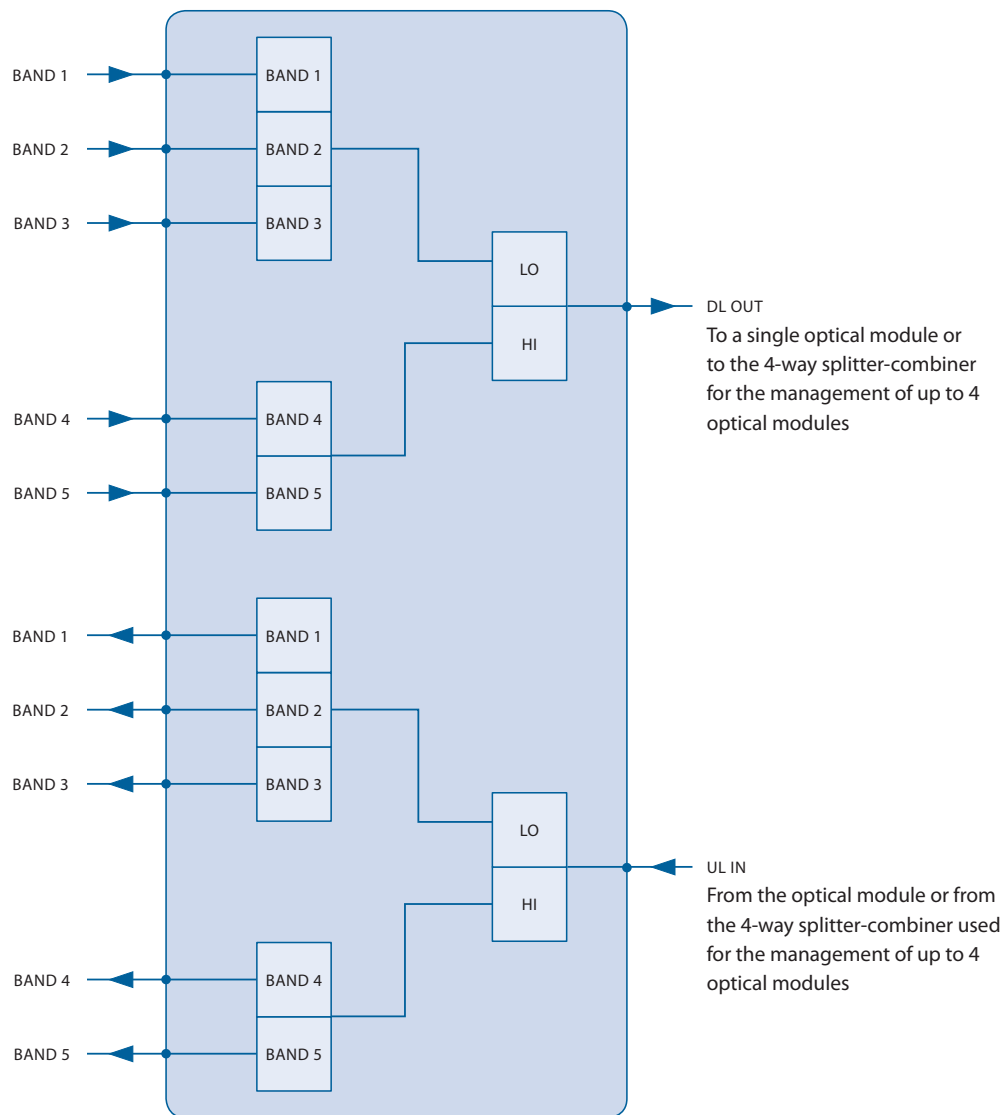


Label	Description
DL OUT	Downlink path output connector
UL IN	Uplink path input connector
Band (or Bands) 1	Band (or Bands) 1 input (downlink path)
	Band (or Bands) 1 output (uplink path)
Band (or Bands) 2	Band (or Bands) 2 input (downlink path)
	Band (or Bands) 2 output (uplink path)
Band (or Bands) 3	Band (or Bands) 3 input (downlink path)
	Band (or Bands) 3 output (uplink path)
Band (or Bands) 4	Band (or Bands) 4 input (downlink path)
	Band (or Bands) 4 output (uplink path)
Band (or Bands) 5	Band (or Bands) 5 input (downlink path)
	Band (or Bands) 5 output (uplink path)

• **Pentaplexer**

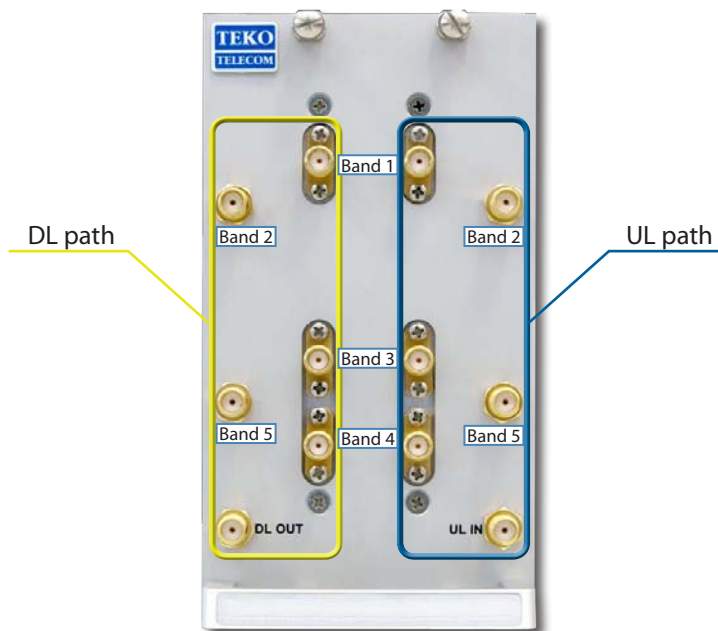
The Pentaplexer is used in multi-band configurations to distribute signals operating over up to 5 different bands.

The Pentaplexer can be connected to a 4-way splitter/combiner in order to manage up to 4 Fiber Optic Transmitter/Receiver Modules (i.e. up to 16 Remote Units).



Example: 3-Low-band- + 2-High-Band Pentaplexer block diagram

• Pentaplexer Access Points



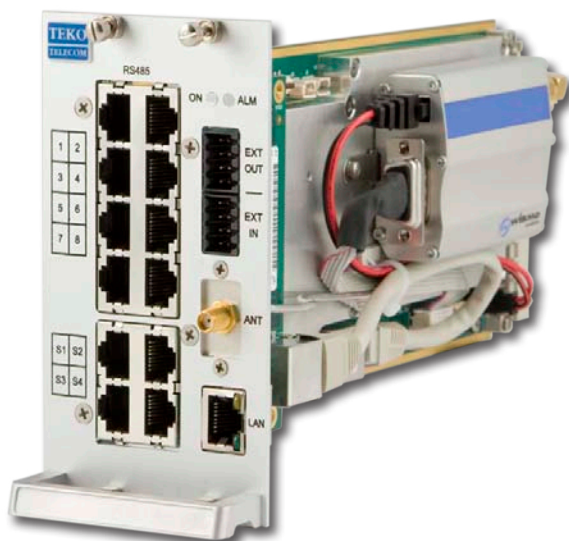
Label	Description
DL OUT	Downlink path output connector
UL IN	Uplink path input connector
Band 1	Band 1 input (downlink path)
	Band 1 output (uplink path)
Band 2	Band 2 input (downlink path)
	Band 2 output (uplink path)
Band 3	Band 3 input (downlink path)
	Band 3 output (uplink path)
Band 4	Band 4 input (downlink path)
	Band 4 output (uplink path)
Band 5	Band 5 input (downlink path)
	Band 5 output (uplink path)

A.2.5 Modules for the management of the System

• Supervision Module

The Supervision Module (TSPV) allows the control and management of the entire Coverage and Capacity System. The Supervision Module is provided with its own TCP/IP address and with a built-in web server that allows control and management via a standard web browser. The Coverage System can be accessed either via a physical (Ethernet LAN) connection or via a modem connection.

Up to 13 Active Subracks can be monitored connecting a PC, either locally or remotely, to the Ethernet port (LAN, RJ45 connector), available on the Supervision Module front panel.



Supervision Module equipped with optional built-in wireless modem



Supervision Module with RS232 port

For remote control the System can also be accessed via optional wireless modem (integrated inside the supervision module).

When the optional built-in wireless modem is equipped an SMA input/output connector is available on the Supervision front panel for remote management.

When the optional built-in wireless modem is not equipped, an RS232 port is available on the Supervision front panel for connection to an external modem.

A VPN application is installed on the Supervision Module to provide remote and secure access to the System using the Internet.

The Supervision Module can also act as an SNMP-agent providing integration into upper-level management systems (NEM).

4 external alarm inputs and 4 dry contact outputs are available on the Supervision module front panel.

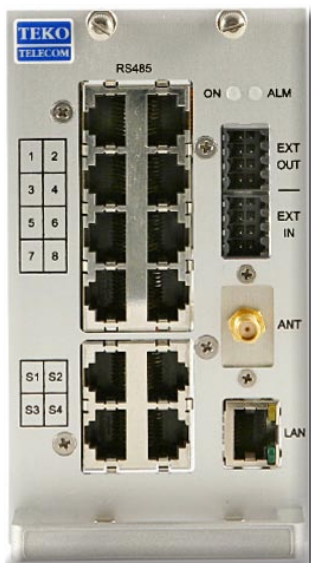
The 4 Input lines are opto-isolated and are activated by a short circuit between input pins (max current flow during short = 6mA; max Vdc at input pins = 3.3V).

Please refer to Paragraph B.3.4 for details about external alarms connections.

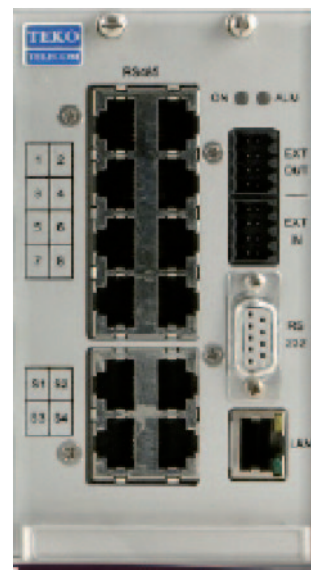
Teko Telecom Operation and Maintenance Terminal (OMT) web pages allow the commissioning, monitoring, setting and troubleshooting of the whole Coverage and Capacity System via a user friendly graphical interface.

Teko Telecom OMC (Operation Management Centre) proprietary software is available to control multiple Supervision Modules managing different Coverage and Capacity Systems in a Network.

Supervision Module Access Points



Supervision Module equipped with optional built-in wireless modem



Supervision Module with RS232 connector

Label (Connectors)	Description
RS485 (1 to 8)	RJ45 connectors for the management of monitored Active Subracks, mounted within the same rack cabinet hosting the Supervision module
RS485 (S1 to S4)	RJ45 connectors for the management of remote Active Subracks equipped with Point to Point slave modules. When not connected to remote Subracks, these ports can be used to manage additional Active Subracks (exceeding 8) mounted within the same rack cabinet hosting the Supervision module
EXT OUT	External alarms 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 wireless modem antenna SMA connector
LAN	RJ45 connector Local Control Interface

Label (LEDs)	Description
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 Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

- **Alarm Board**

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



Alarm Board equipped with 16 input pins - TEA-I16

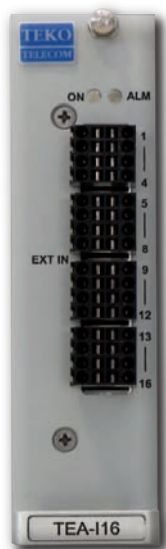
16 external alarm inputs are available on the Alarm Board front panel.

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

Inputs 1-to-4 can be switched to dry output contacts upon request.

Please refer to the Supervision Module external alarms connection (Paragraph B.3.4) for details about external alarms connections.

Alarm Board Access Points



Alarm Board
with female dry connectors



Alarm Board
without female dry connectors

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

Label (LEDs)	Description
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 Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

A.2.6 Power Supply Components

- Power Supply Modules (TPSU)

Power Supply modules are either AC-to-DC or DC-to-DC plug-in modules that provide power to Sirius Active Subracks. Each module provides up to 100W output power; several modules can be connected in parallel (please refer to the SIRIUS datasheet for details about derating factors). Hot-plug 1+1 Redundancy feature is supported: it can be implemented to achieve high system reliability.

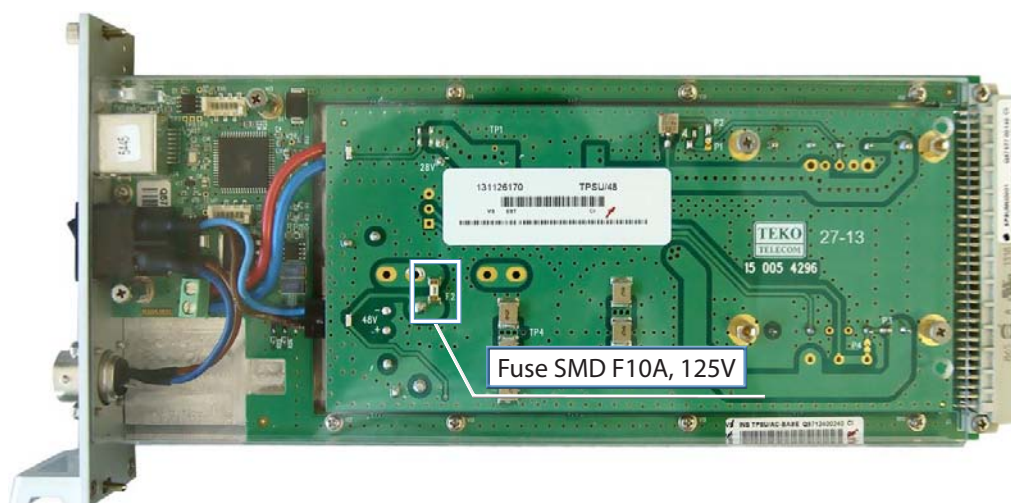


TPSU/AC



TPSU/48

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.



Power Supply modules can be equipped in monitored Active Subracks, in the Master Active

Subrack or in a dedicated Active Subrack.

When Power Supply modules are equipped in monitored Active Subracks, the RJ45 connector available on the Power Supply Module front panel can be used for connection to the Supervision Module, equipped in the Master Active Subrack.

Power Supply Modules Access Points



AC MAINS switch

TPSU/AC

AC/DC Power Supply Module



DC switch

TPSU/48

DC/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)

Label (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 Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

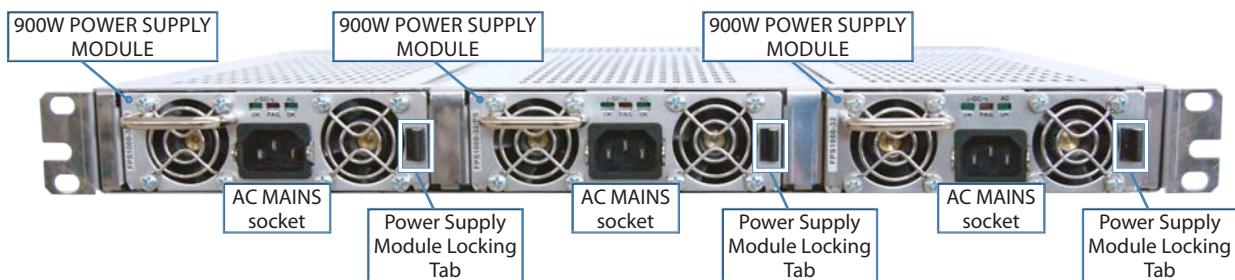
• **Power Supply Subracks**

The AC-to-DC and DC-to-DC Power Supply subracks allow a reduction in the amount of space required for the System installation: they can be equipped with up to 3 Power Supply modules to provide up to 2.4kW (SUB-PSU-MU)/3kW (SUB-PSU-MU/48) output power in just one height unit space. Hot-plug 1+1 Redundancy feature is supported: load-sharing power supply modules can be installed to achieve high system reliability. Hot-plugging allows a faulty power supply module to be replaced without powering off the system.

The power supply subracks allow the reset of the whole Master Unit, or PTP Slave subrack, from the System management software (OMT webpages / OMC proprietary software).

► **SUB-PSU-MU: the AC-to-DC Power Supply Subrack** can be equipped with up to 3 AC/DC Power Supply modules to provide up to 2.4kW output power.

Front Access Points



SUB-PSU-MU Power Supply subrack (maximum configuration 2.4kW output power) - Front view

Connectors	Description
AC MAINS	AC MAINS socket (100-240Vac)

Label (LEDs)	Description	
AC	ON (green) when AC input is present	
DC	OK	ON (green) when DC output is available
	FAIL	ON (RED) when DC output is unavailable

Rear Access Points

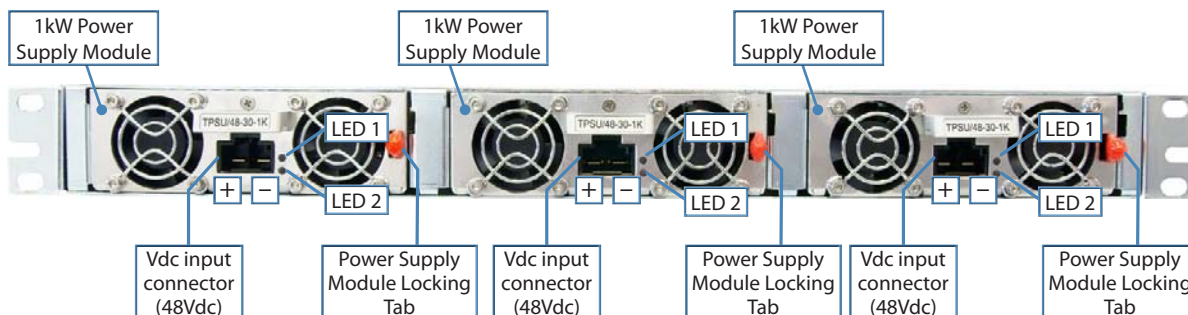


SUB-PSU-MU Power Supply subrack - Rear view

Connectors	Description
GROUND	Equipment grounding
RS485	RJ45 connector for RS485 connection to the Supervision Module
Vdc outputs	28Vdc Outputs (max 10A each)

- ▶ **SUB-PSU-MU/48 : the DC-to-DC Power Supply Subrack** can be equipped with up to 3 DC/DC Power Supply modules to provide up to 3kW output power.

Front Access Points



SUB-PSU-MU/48 Power Supply subrack (maximum configuration 3kW output power) - Front view

LEDs Description

LED 1	ON (green) when DC input is present
LED 2	OFF: regular operation ORANGE: fan fail alarm RED: DC output voltage alarm or communication alarm

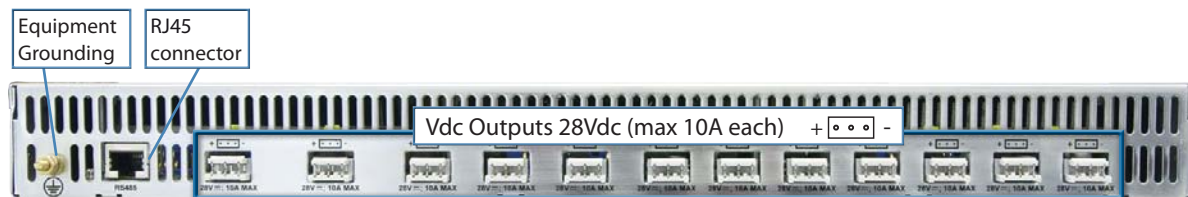
Please note

Each DC input is protected by fuses:



DC/DC Power Supply module (TPSU/48-30-1K) input protection fuses - position and electrical rating

Rear Access Points



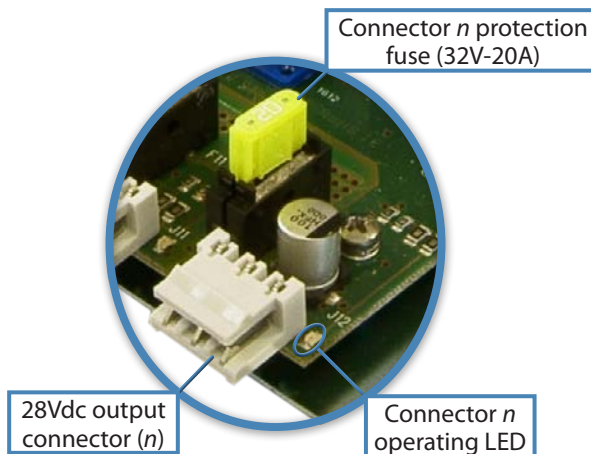
SUB-PSU-MU/48 Power Supply subrack - Rear view

- ▶ **SUB-PSU-MU and SUB-PSU-MU/48:** each Vdc output connector is protected by a fuse.



SUB-PSU-MU and SUB-PSU-MU/48 protection fuses position

If a fuse blows, the management software reports an Output Voltage alarm for the connector involved and the green led to the right of the connector switches off. The fuse has to be replaced.



Detail: Connector n protection fuse and operating status led

Please note

DC/DC Power Supply modules (TPSU/48-30-1K) can be equipped in the SUB-PSU-MU/48 subrack only.

AC/DC Power Supply modules (TPSU/AC-30-1K) can be equipped in the SUB-PSU-MU subrack only.

• **Power Supply distribution system**

A Power Supply distribution system is available for the remote powering of Teko Telecom 48V_{DC} Low Power Remote Units.

The Power Supply distribution system is composed of both a Power Supply Unit (PSU) and a Power Distribution Unit (PDU), housed in a 19"-2U subrack. The power supply unit can be equipped with up to 4 current-sharing Power Supply modules (either AC/DC or DC/DC).

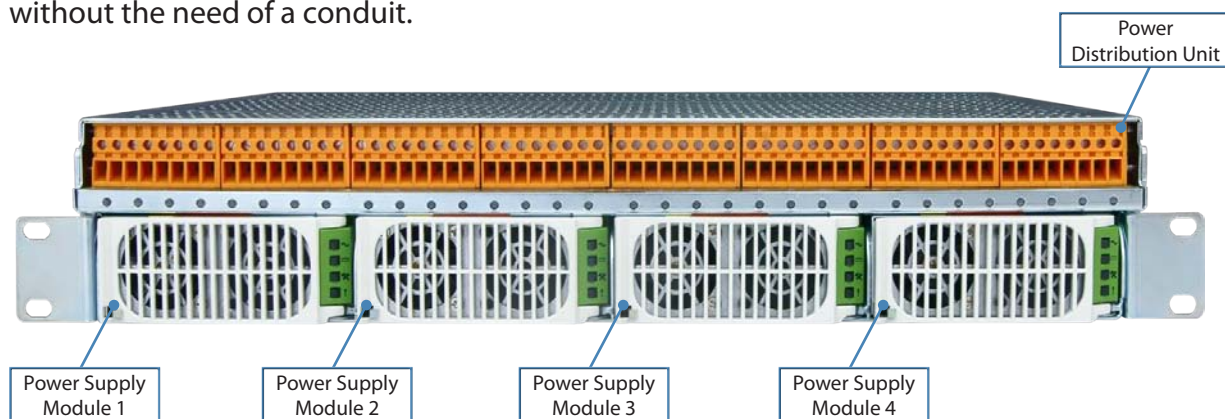
Hot-plug N+1 redundancy feature is supported to offer higher reliability.

The voltage from the power supply modules is made available to the 32 ports on the distribution unit front panel.

A Class 2 DC Distribution Unit version is available to meet the requirements of the US National Electrical Code (NEC).

Please note

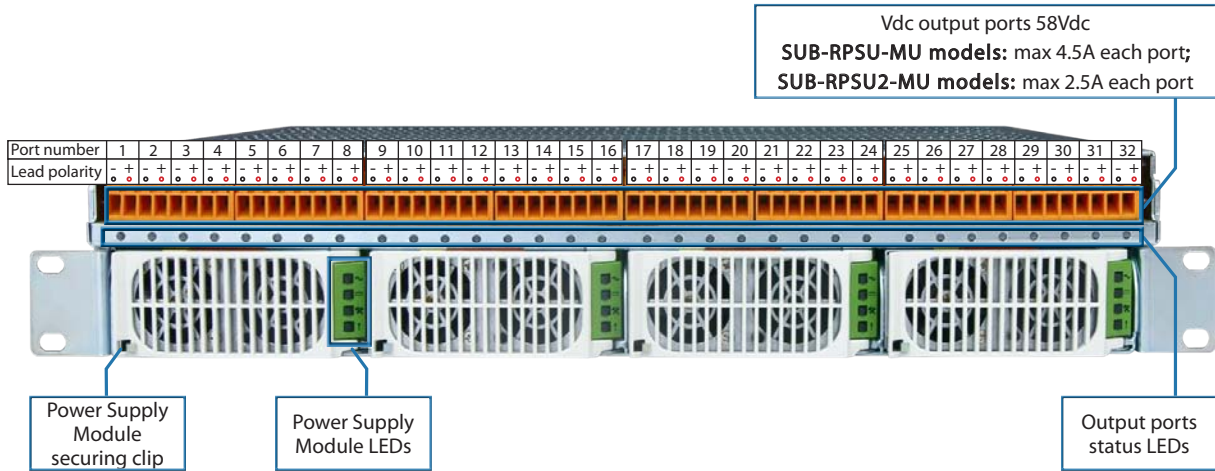
Class 2 distribution systems allow power supply cables to be installed throughout the building without the need of a conduit.



Power Supply distribution system - Front view

Component	Commercial code	Description
Power Distribution Unit (PDU)	SUB-RPSU2-MU/AC	Class 2 DC Distribution Unit and Subrack
	SUB-RPSU2-MU/48	Class 2 DC Distribution Unit and Subrack
	SUB-RPSU-MU/AC	Standard DC Distribution Unit and Subrack
	SUB-RPSU-MU/48	Standard DC Distribution Unit and Subrack
Power supply modules (1 to 4)	TRPSU/AC-58-1.2K	AC/DC power supply module
	TRPSU/48-58-2K	DC/DC power supply module

Power Supply distribution system components



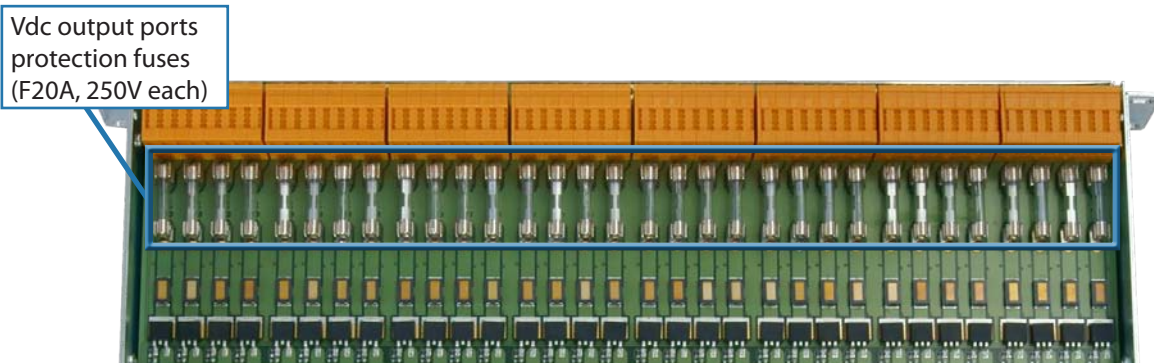
Power Supply distribution system - Front view - Access points

32 LED indicators on the front panel of the Power Distribution unit show the status of each output port as follows:

Led status	Description
OFF	Switched off port
ON	Green: regular functioning (normal operation)
	Orange: the port is not operating properly (current absorption out of range)
	Red: no output voltage (port hardware overload protection or broken fuse)

Please note

Each DC output port is protected by a fuse:



Output port protection fuses - position and electrical rating

Four LED indicators are available on the front panel of each Power Supply Module.

Front Panel LEDs description:

- TRPSU/AC-58-1.2K

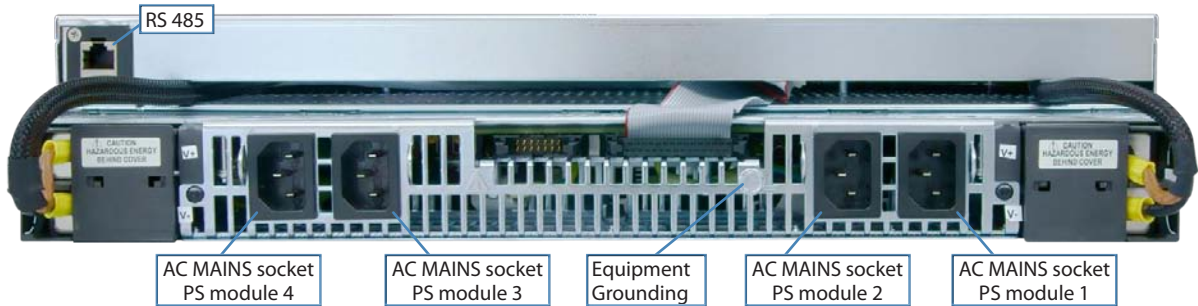
Symbol	Description
~	ON: input ok Blinking: input out of limits
≡	ON: output ok Blinking: overload OFF: no DC output
✖	ON: over-temperature warning Blinking: service
!	ON: fault

- TRPSU/48-58-2K

Symbol	Description
⊖	ON: input ok Blinking: input out of limits
⊕	ON: output ok Blinking: overload
✖	ON: over-temperature warning Blinking: service
!	ON: fault

- ▶ **SUB-RPSU2-MU/AC** and **SUB-RPSU-MU/AC**: power supply distribution system equipped with AC/DC power supply modules

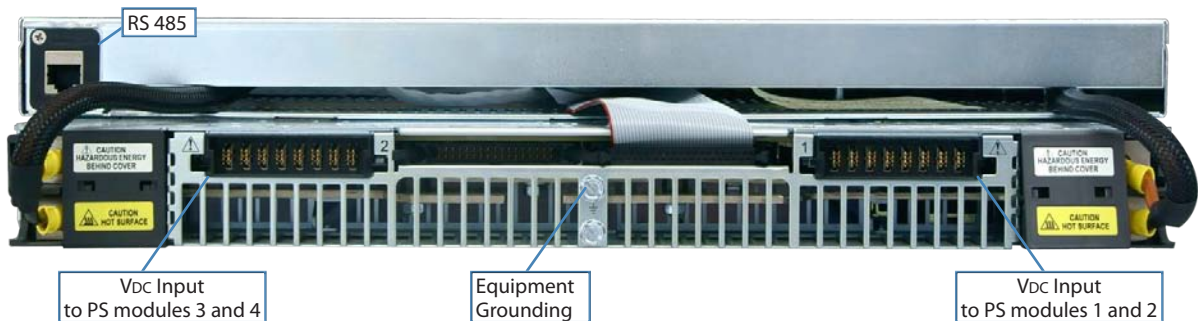
Rear Access Points



SUB-RPSU2-MU/AC and SUB-RPSU-MU/AC - Rear view - Access points

- ▶ **SUB-RPSU2-MU/48** and **SUB-RPSU-MU/48**: power supply distribution system equipped with DC/DC power supply modules

Rear Access Points



SUB-RPSU2-MU/48 and SUB-RPSU-MU/48 - Rear view - Access points

A.2.7 Subracks hosting the System modules

• Active subracks (SUB-TRX-PSU)

Active Subracks are provided with a backplane that allows the management and power supply of up to 12 active modules.

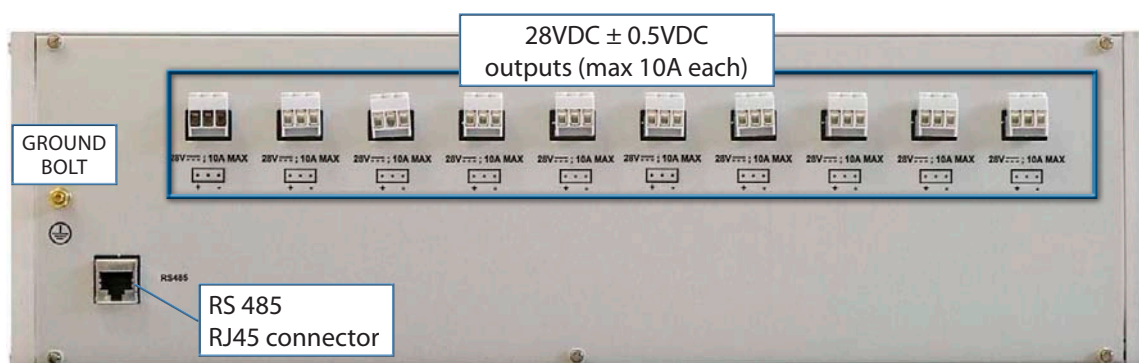
The following connectors are available on each active subrack rear panel:

- a ground bolt;
- one or more 28Vdc input/output connectors;
- an RJ45 connector (RS485) to be used to connect monitored Active Subracks to the RS485 ports, available on the front panel of the Supervision Module (when power supply modules are not equipped in monitored Active Subracks).

Please note

Master SUB-TRX-PSU: the RJ45 connector, available on the rear panel of the SUB-TRX-PSU hosting the Supervision module, is used only when the System is equipped with the SUB-PSU-MU in addition to other 12 monitored Active Subracks, connected to the Supervision Module RS485 front ports. It provides an additional port for the management of the power supply subrack.

Remote SUB-TRX-PSU: the RS485 port, available on the rear panel of a Remote Point to Point Slave Subrack, is used only when a SUB-PSU-MU or SUB-PSU-MU/48 subrack is installed to provide power supply to the remote subracks.



Active Subrack - rear view

Deep subracks (SUB-TRX-PSU-D)

19" - 3U, 360mm (14.17in) deep subracks are required to host fully equipped Digital Donor Front End modules.

Please note

Extender boards are required to plug standard-depth modules into deep subracks.



Teko Telecom Extender Board (TME-SUB-TRX-D)

- **Passive subracks (SUB-HPOI)**

Passive modules that do not require power nor management to function can be housed in Passive subracks thus allowing a reduction in the cost of the whole system.

A.2.8 Forced-air cooling Subrack

Teko Telecom forced-air cooling subrack is able to provide a maximum air flow of 180cfm (5m³/min) in order to ensure the proper operation of cabinet installed equipment.

Forced-air cooling Subrack Access Points



Forced-air cooling subrack - Front view



Forced-air cooling subrack - Rear view

Access Point	Description
LED	Forced-air cooling subrack general operating status LED Green: normal operation Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level
RS485	RJ45 connector for RS485 connection to the Supervision Module
28V DC; 10A MAX	28VDC ± 0.5VDC input (max 10A)
GND	Equipment grounding

Let us repeat!



a JMA company

Part

A

SIRIUS: Teko Telecom Modular Coverage and Capacity System General Description – Components and Solutions



Coverage Solutions

A3 Coverage and Capacity Solutions

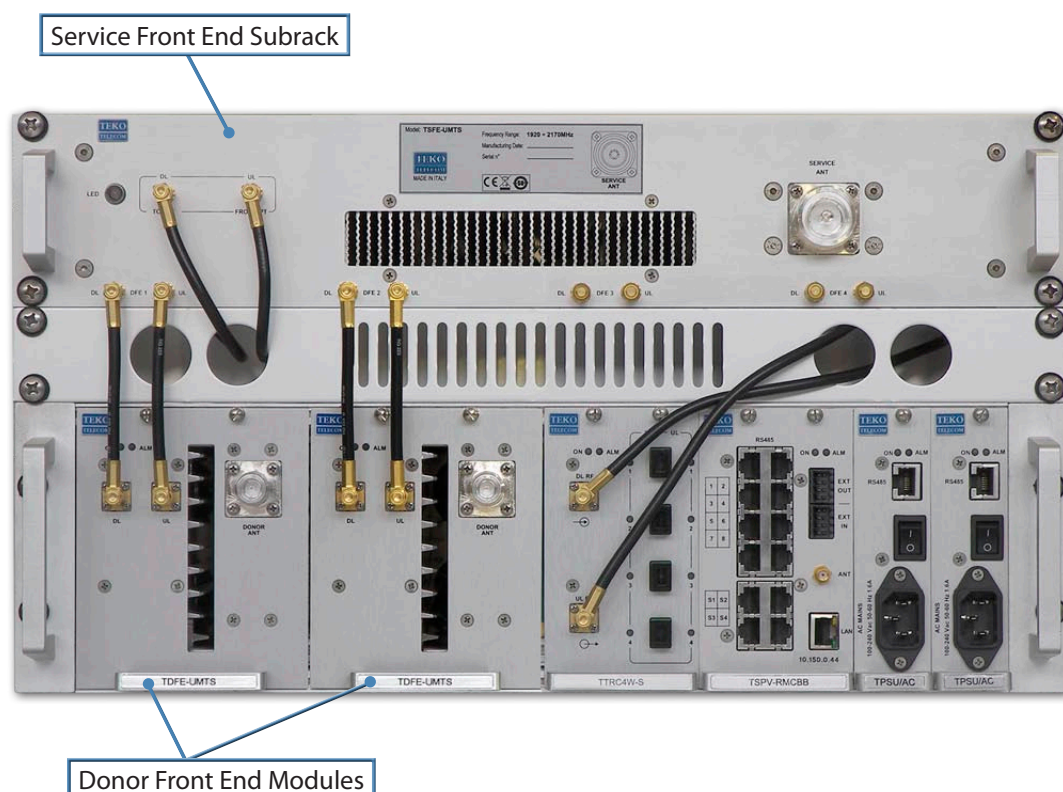
The components of SIRIUS, Teko Telecom Modular Coverage and Capacity System, can be assembled to provide Modular Repeaters, Optical Systems and integrated solutions to improve coverage in different environments.

A.3.1 Modular Off-air Repeaters

Teko Telecom multi-band multi-operator Off-air Modular Repeaters represent the ideal solution for cellular coverage extension, offering a cost effective alternative to dedicated BTS or NodeB/e-NodeB. They operate over different frequencies and with various frequency combinations in the 380 to 2700MHz frequency range.

No physical connections are required between the Modular Repeaters and the cellular network: the Digital Donor Front End Module is connected to a Donor Antenna, providing the connection towards a BTS or NodeB/e-NodeB over an air link.

Teko Telecom Modular Off-air Repeaters can be set up by proper combination of Digital Donor Front End Modules and Service Front End Subracks.



The **Digital Donor Front End** is the single-band/single-operator RF interface towards the signal source; the **Service Front End** is the multi-band/single operator equipment that

provides enhanced wireless signal to the area to be covered.

Off-air Modular Repeaters can be equipped with one Donor Front End or more Donor Front End modules to make multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).

A single-band single-operator Repeater can be set-up combining a Digital Donor Front End Module and a Service Front End Subrack.

Up to 4 Digital Donor Front End Modules can be connected to a single Service Front End obtaining a single-band 4-operator Off-air Repeater.

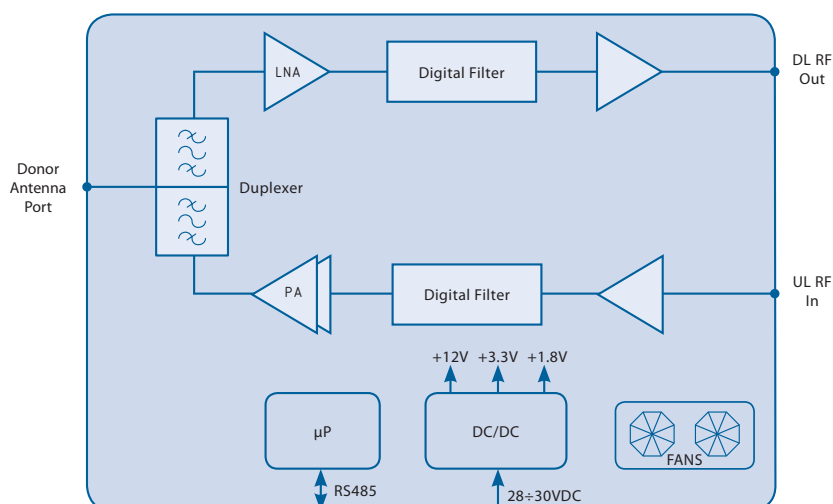
Digital Donor Front End Modules can be connected to different Service Front End Subracks to provide multi-band/multi-operator Systems.

Operating principle

Modular repeaters use a directional antenna to interface with the operator's donor BTS (or NodeB/e-NodeB) and one or more service antennas to transmit the amplified wireless signals to the area to be covered.

In down-link the repeater receives the signals from the BTS (or NodeB/eNodeB), amplifies them and re-transmits them to the mobiles. In the up-link path the repeater receives the signals from the mobiles (MS), amplifies them and re-transmits them to the base station.

Each TDFE module hosts the duplexer, to be connected to the Donor Antenna to separate/combine Downlink and Uplink paths.



In downlink the signal from the Donor antenna is preamplified by a Low Noise Amplifier and

converted into an IF signal by a down converter. The selection of the band of frequencies to be extended is handled by a digital filter: in standard TDFE versions the digital filter can manage 1 variable band or 2 variable sub-bands, in fully equipped versions it is able to manage up to 9 variable sub-bands.

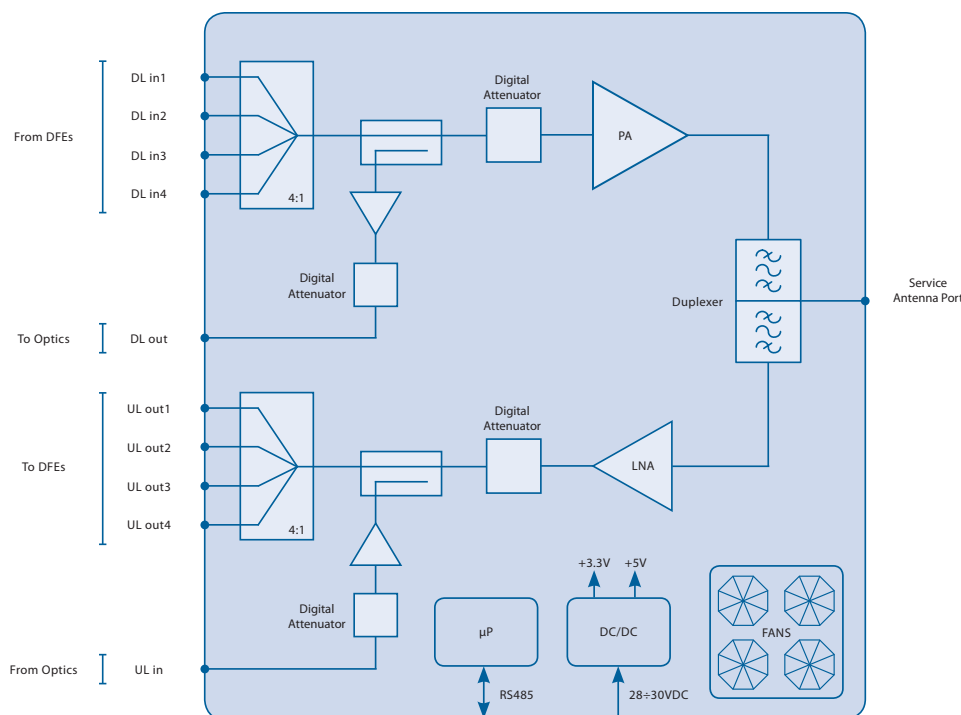
An up converter converts the IF signal into an RF signal.

In uplink the signal from the Service Front End Subrack is converted into an IF signal by a down converter, filtered and re-converted into an RF signal, amplified by a power amplifier and re-transmitted to the signal source.

Each TSFE subrack hosts the duplexer, to be connected to a Service antenna to separate/combine Downlink and Uplink paths.

In Downlink the signals from the Donor Front-End Modules are combined, amplified (High Power Amplifier) and then transmitted to the area to be covered by the Service Front End Subrack.

In Uplink, the RF signal from the Service antenna is amplified by a Low Noise Amplifier (LNA) and split to feed up to 4 Donor Front-End Modules.



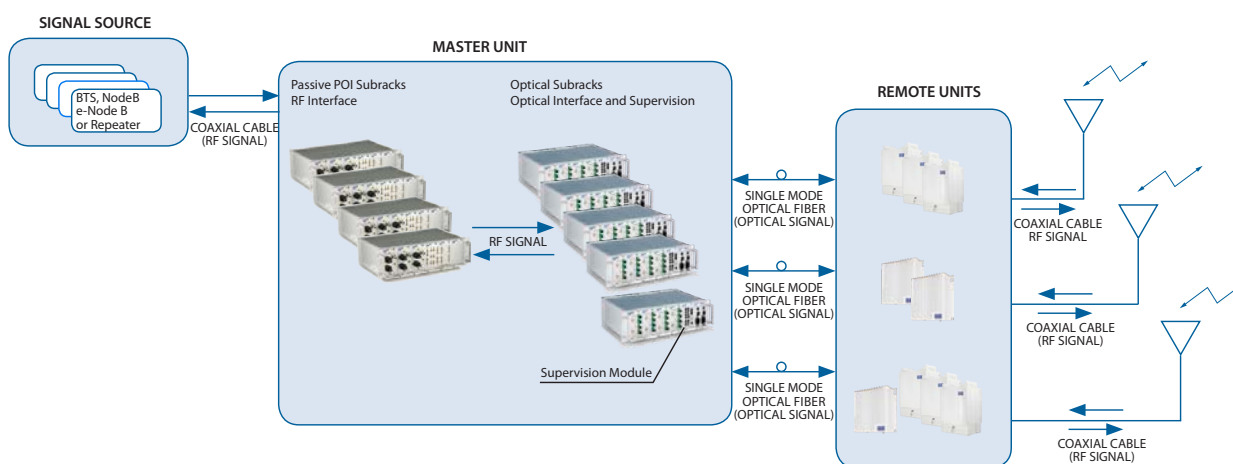
When Modular Repeaters do not provide satisfactory coverage (extensive areas, long tunnels), they can be used along with a fiber fed System (Teko Telecom Optical System).

A.3.2 Optical Systems

Teko Telecom Coverage and Capacity System components can be configured to provide a modular multi-band multi-operator Optical System.

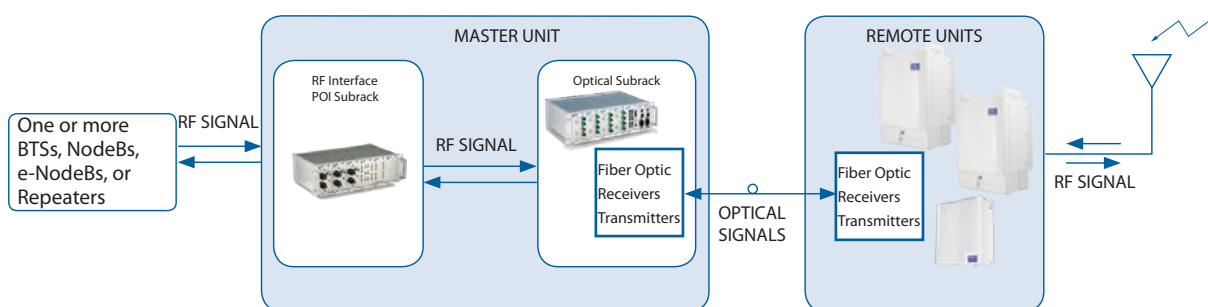
Optical Systems are based on the Radio over Fiber technology, which enables radio signals transmission over optical fiber. This technology offers wide bandwidth and very little loss along the fiber optic cable, allowing the signals to be propagated over long distances. This allows extensive areas coverage.

Each Teko Telecom Optical System is made up of two main parts: the Master Unit, interfacing the signal source, and Remote Units, distributed throughout the territory to be served. Master Unit and Remote Units are connected via single mode optical fiber (SMR 9/125).



A – Master Unit

The **Master Unit** provides both the RF interface towards the signal source (one or more BTSs or NodeBs/e-NodeBs) and the optical interface towards Remote Units.



It is a rack-based modular equipment: Teko Telecom Coverage and Capacity Systems components can be assembled in a variety of ways providing different Master Unit configuration

options.

Each Master Unit can be equipped with one or more RF interface subracks (subracks hosting RF interface modules) and with one or more Optical Subracks (Active Subracks hosting Fiber Optic Transmitter/Receiver modules).

When the Master Unit is equipped with Master and Slave Point to Point Modules, RF interface subracks and optical subracks can be separated by a maximum distance of 20km.

- **RF interface subracks**

RF Interface subracks operate over different frequencies and with various frequency combinations in the frequency range from 380 to 2700MHz.

Each RF interface subrack can be equipped with one or more RF Interface modules. Each module interfaces to a single mobile operator / mobile standard signal source, making multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).

Master Unit RF Interface modules can be Point of Interface (POI/TAPOI/TDTPOI) modules and/or Donor Front End modules.

Point of Interface modules are connected to the signal source via coaxial cable: each **POI/TAPOI** module is connected to a single operator/ single standard signal source (BTS or NodeB/e-NodeB). DAS Tray Point of Interface (TDTPOI) modules are used in Optical DAS Systems to directly (no external directional coupler nor load needed) interface up to 2 BTSs or NodeBs/e-NodeBs, either duplex or simplex, with or without diversity, SISO or MIMO 2x2.

Master Units equipped with POI/TAPOI/ TDTPOI modules must be installed next to the donor BTS or NodeB/e-NodeB).

POI modules can be equipped in passive subracks; TAPOI/TDTPOI modules require active subracks (SUB-TRX).

Donor Front End modules allow the Optical System to be driven without the need of a dedicated BTS or NodeB/e-NodeB: each Donor Front End module interfaces with a Donor Antenna oriented towards a BTS or NodeB/e-NodeB (connection over an air link).

Active Subracks are required to host Digital Donor Front Ends; fully equipped Digital Donor Front Ends require deep Active Subracks (depth = 360mm / 14.17in). Each subrack can be equipped with up to 4 Donor Front End Modules.

RF Interface subracks also host **passive modules providing distribution and filtering**:

- 1:4 Splitter/Combiner
- Band Splitter/Combiner (Triplexer) with or without built-in 1:4 Splitter/Combiner
- Pentaplexer/Esaplexer.

Due to the flexible configuration options of Teko Telecom Coverage and Capacity Systems, the same passive modules can be used for different purposes:

- the 4-way splitter/combiner can be used to manage: multiple RF interface modules, operating in the same band (Multi-Operator Optical Systems) or multiple Fiber Optic modules;
- the triplexer (with built-in 4-way Splitter/Combiner) can be used to manage
 - up to 3 RF interface modules operating in different bands (and up to 4 Fiber Optic Transmitter/Receiver Modules) or
 - up to 3 Service Front End subracks operating in different bands (and up to 4 Fiber Optic Transmitter/Receiver Modules) or
 - up to 3 four-way splitter/combiner modules, used to manage multiple RF interface modules -up to 4 for each band (and up to 4 Fiber Optic Transmitter/Receiver Modules).
- the Pentaplexer and Esaplexer can be used to manage
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) RF interface modules operating in different bands or
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) Service Front End subracks operating in different bands or
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) four-way splitter/combiner modules- used to manage multiple RF interface modules (up to 4 for each band).

The RF Interface subracks can also be equipped with up to 4 Master Point to Point modules for the management of up to 4 optical subracks installed in different remote locations.

Digital Donor Front End modules can be connected to Service Front End Subracks to provide coverage to the area adjoining the Master Unit site.

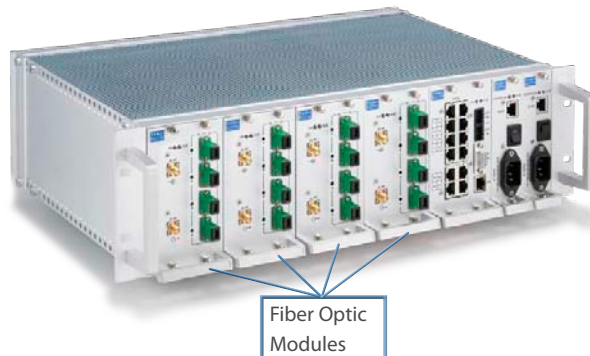
Each Service Front End can be fed by up to 4 Donor Front-End Modules interfacing the signal source. Downlink and uplink auxiliary ports are available to drive the Optical System.



Service Front End Subrack

• **Optical Subracks**

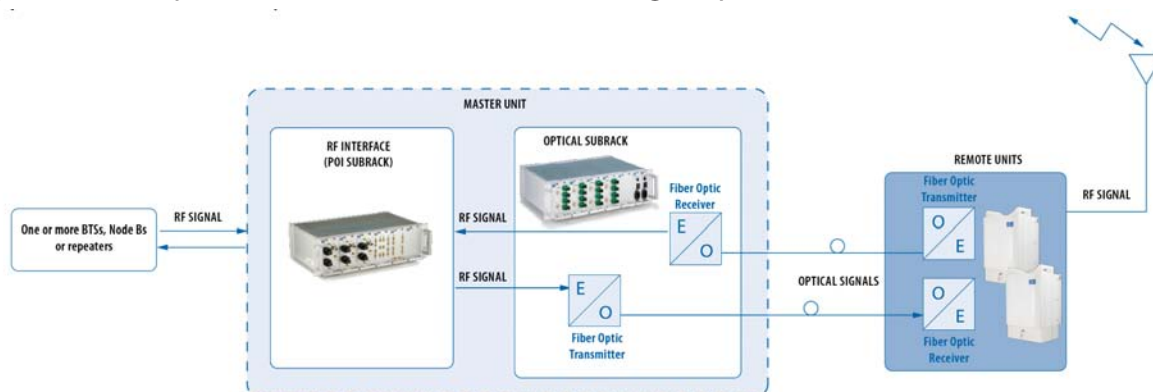
Optical Subracks are Active Subracks hosting Fiber Optic Transmitter/Receiver modules.



Fiber Optic Transmitter/Receiver modules are the optical interface towards Remote Units: they provide 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).

Up to 6 Fiber Optic Modules can be housed in a single Optical Subrack.



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 fiber 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 fiber 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.

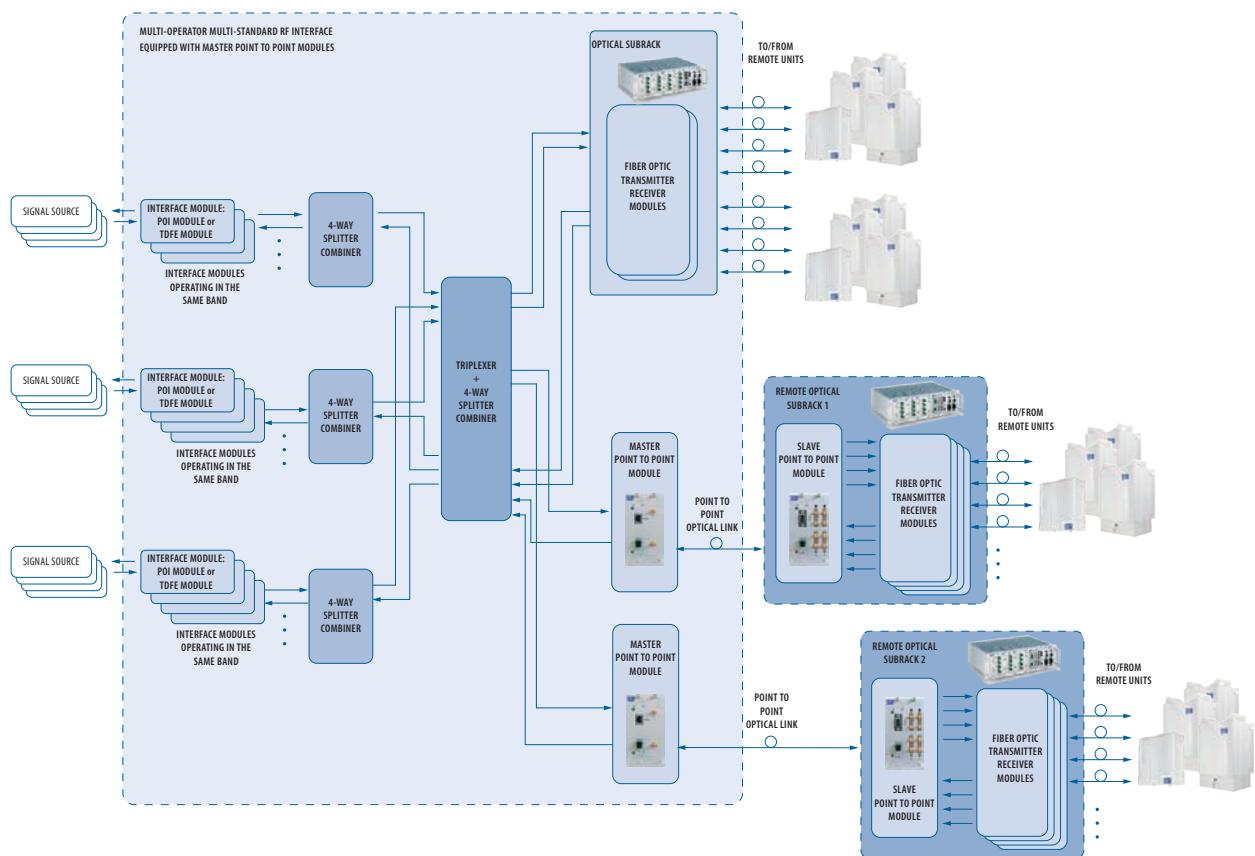
Uplink and downlink optical signals are transmitted over the same single mode optical fiber (Wavelength Division Multiplexing -WDM- technology).

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

When the Coverage System includes point to point links, the remote optical subracks host the Slave point to point modules to be connected, via optical fiber, to their Master Point to Point modules, equipped in the RF interface subracks.

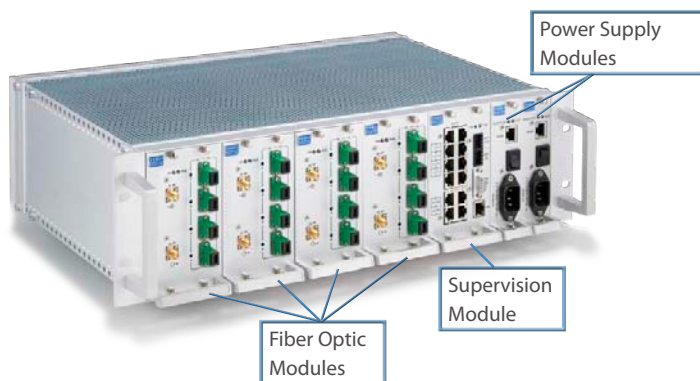
The slave point to point module includes the 4-way splitter/combiner to manage up to 4 Fiber Optic Transmitter/Receiver Modules and a built-in Supervision unit for the management of the remote optical subrack, the power supply subrack (SUB-PSU-MU or SUB-PSU-MU/48, when equipped), and all connected Remote Units.

When Remote optical subracks are equipped with 2 or 3 Slave Point to Point Modules only one module is connected to the System Supervision module (the one installed on the left side of the remote subrack - slots 1 to 6).

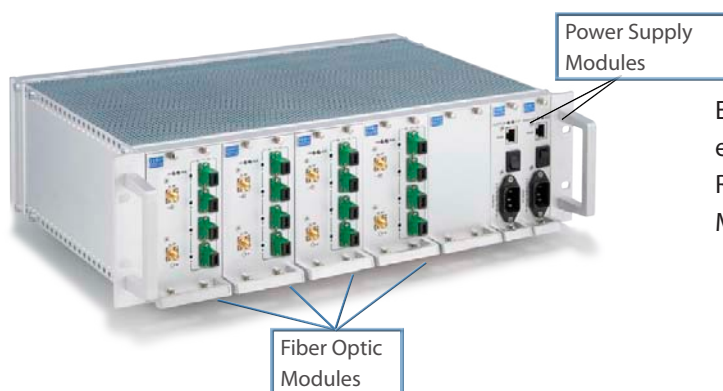


Optical Subracks can be AC or DC powered.

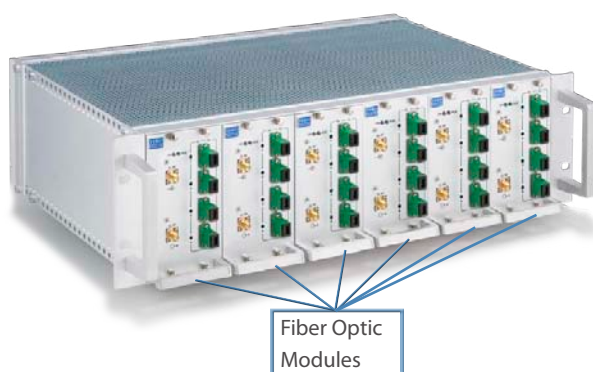
Power Supply modules can be equipped in monitored Optical Subracks or in the Master Optical Subrack or in dedicated Active Subracks.



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



Example of Monitored Optical Subrack equipped with 4 Fiber Optic Transmitter/Receiver Modules and 2 Power Supply Modules



Example of Monitored Optical Subrack equipped with 6 Fiber Optic Transmitter/Receiver Modules

B – Remote Units

Remote Units distribute wireless signals throughout the area to be covered; they can be installed up to 20km (12.4miles) from the Master Unit site.

Remote Units can be Single band or Multi-band with different power classes: Very High, High, Medium and Low.

Pole-mounting Remote Unit mechanical design allows the Unit to be mounted inside utility poles with 12" internal radius. The Unit can also be mounted outside, fastened to a thinner pole, due to its IP66 rating.



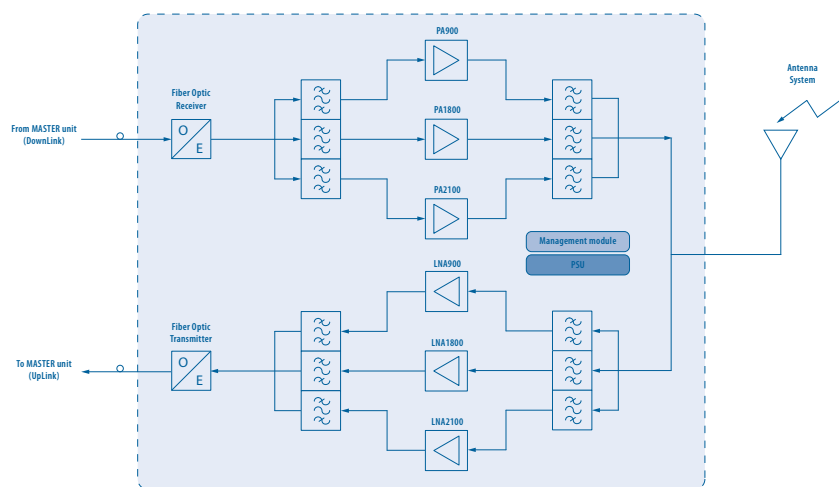
Very High, High Power Remote Unit	Very High, High, Medium Power Remote Unit	Low Power Remote Unit	Low Power Remote Unit
Multi-band	Single, Dual, Tri-band	Single, Dual, Tri-band	4-band,5-band,6-band
Mechanical design optimized for Pole Mounting (inside/outside)	Wall Mounting (pole mounting kit available as option)	Wall Mounting (pole mounting kit available as option)	Wall Mounting (pole mounting kit available as option)

Remote Units are equipped with the Fiber Optic Receiver and Transmitter modules (for Optical to RF and RF to Optical conversion) power amplifiers and filtering.

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 fiber and optimized optical couplers.

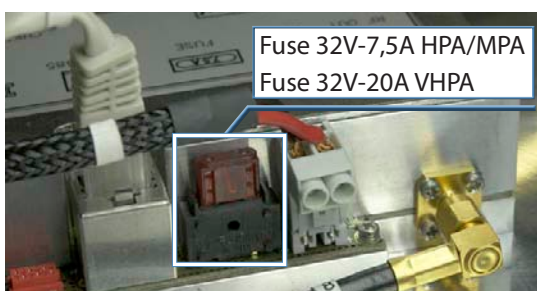
The following figure shows the Tri-band Remote Unit block diagram: in down-link the optical signal from Master Unit is converted into an RF signal by the Fiber Optic Receiver module. RF signals, filtered by the triplexer, are amplified by Low, Medium, High or Very High Power amplifiers (Low, Medium, High or Very High Power Remote Units), filtered and transmitted through an antenna or a passive distribution system.

In up-link the RF signal is filtered by the triplexer. The three RF signals are amplified by Low-Noise Amplifiers, filtered and then converted into an optical signal by the Fiber Optic Transmitter module. The signal is transmitted via fiber optics to the Master Unit.

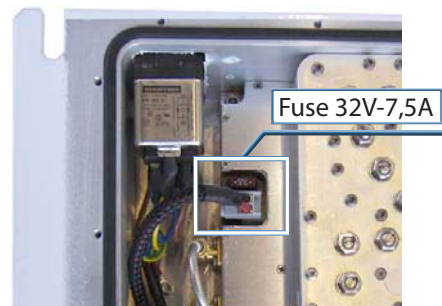


Example: Tri-band Remote Unit block diagram

Please Note: each final power amplifier is protected by a fuse.



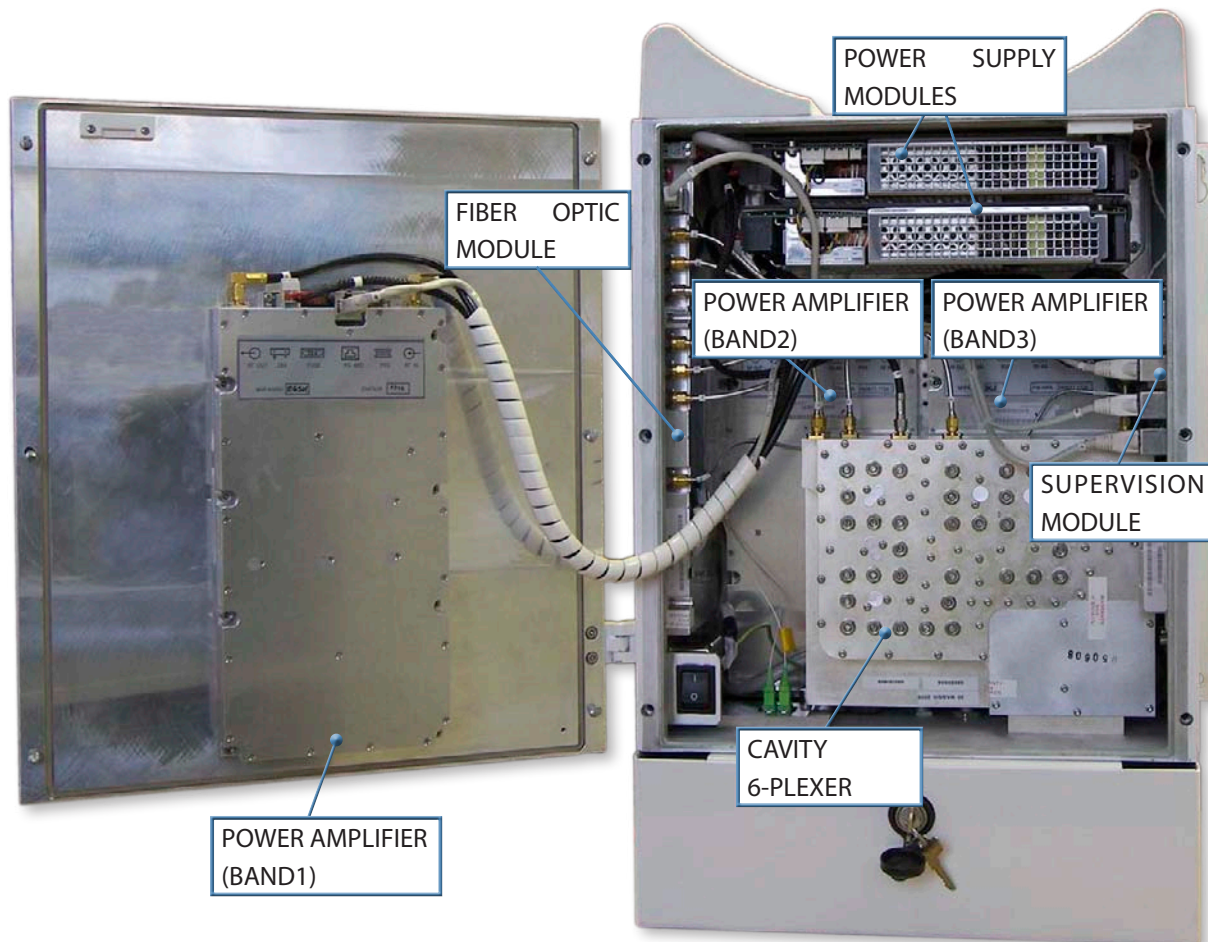
Very High Power/High Power/Medium Power final amplifiers fuse position and electrical rating



Low Power final amplifier fuse position and electrical rating

The management module collects information relevant to the various modules. An RF modem allows data communication over fiber between Remote Unit and Master Unit.

• **High/Medium Power Remote Units Composition**



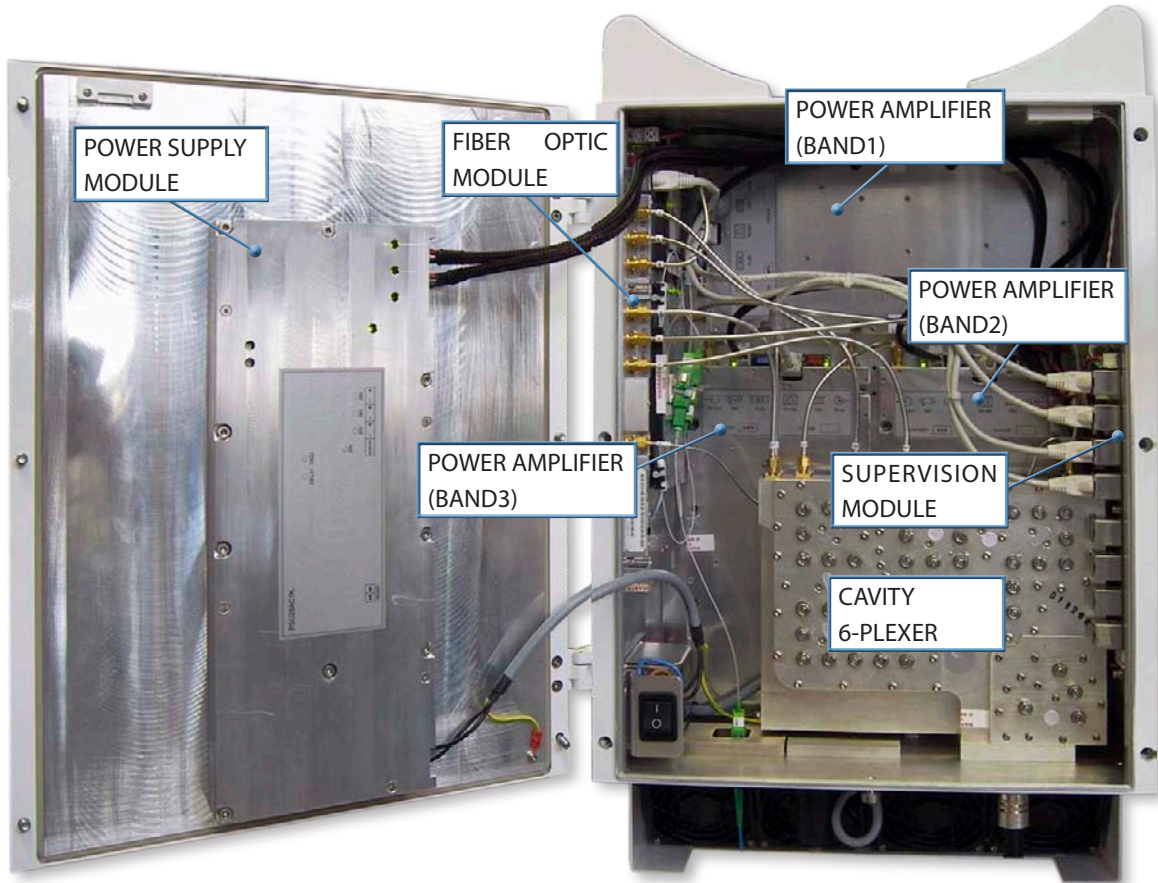
PLEASE NOTE

The Very High/High/Medium Power Remote Unit case is equipped with a lock to guarantee protection of the equipment. The following procedure describes how to open the equipment.

OPENING THE REMOTE UNIT

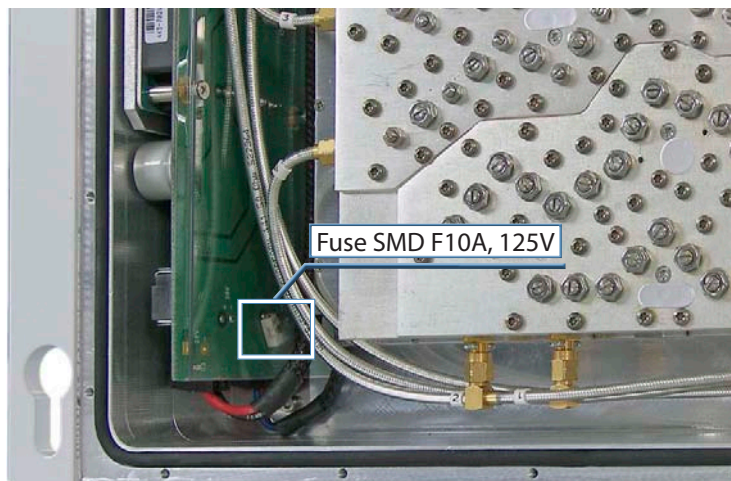
- Unlock the cables protection using the keys delivered with the equipment
- Remove the cables protection
- Remove the Remote Unit cover, sliding it downwards
- Unscrew the 6 screws on the Remote Unit door
- Open the Remote Unit door.

Very High Power Remote Unit Composition

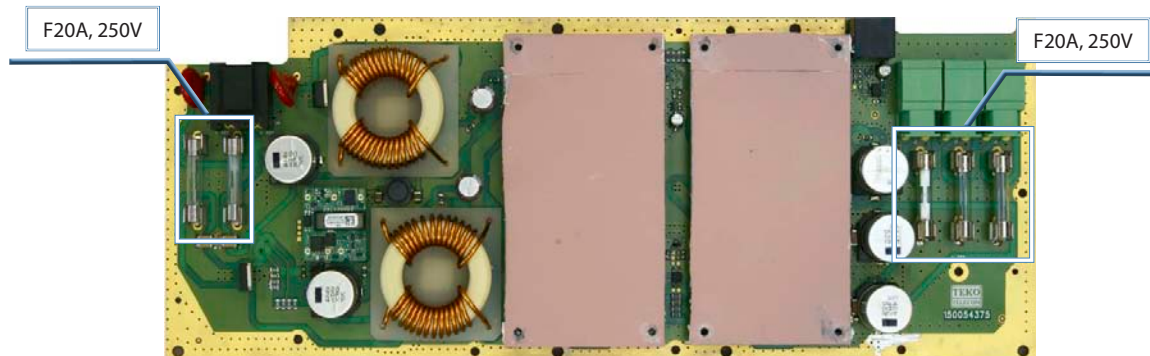


Remote Units can be either AC powered (Universal mains, 85÷264Vac, 50-60Hz) or DC powered (-72 ÷ -36Vdc).

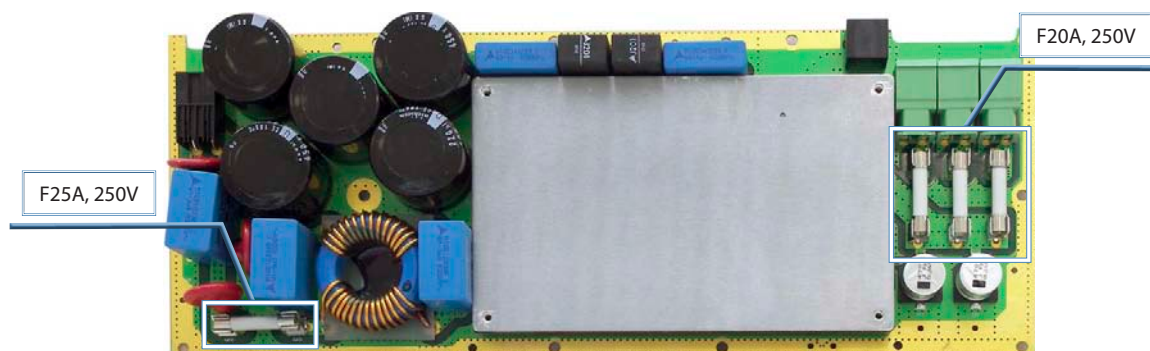
The following figures show power supply modules protection fuses position and electrical rating.



Low Power Remote Unit: DC/DC Power Supply Module protection fuse position and electrical rating



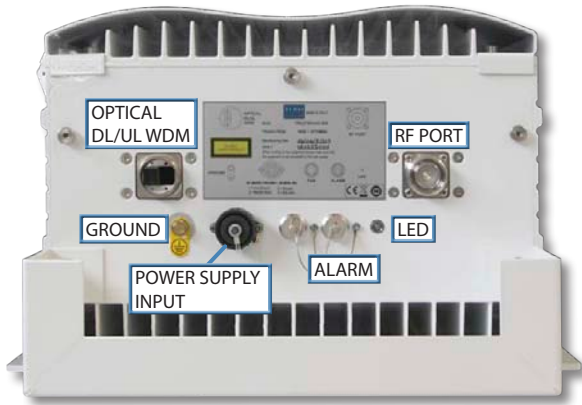
Very High Power and Pole mounting Remote Units: DC/DC Power Supply Module protection fuses position and electrical rating



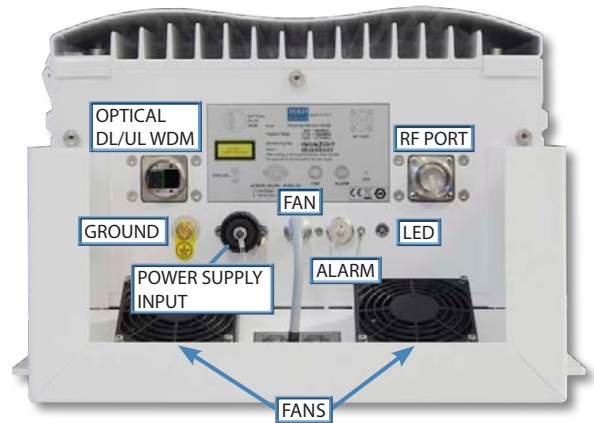
Very High Power and Pole mounting Remote Units: AC/DC Power Supply Module protection fuses position and electrical rating

• Remote Units External Access Points

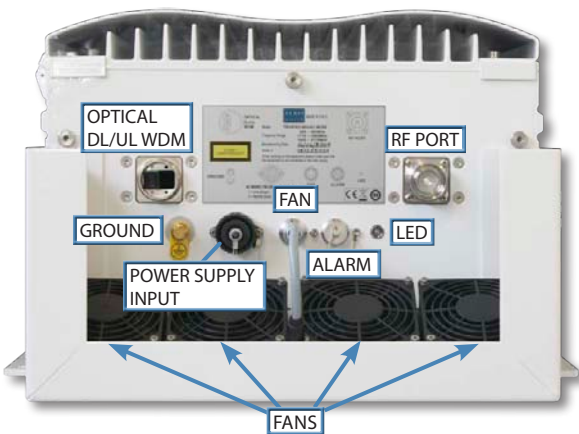
Medium/ High and Very High Power Remote Units External Access Points



Medium power and Single band high power Remote Units
Bottom view



Dual band/Triband high power Remote Units
Bottom view



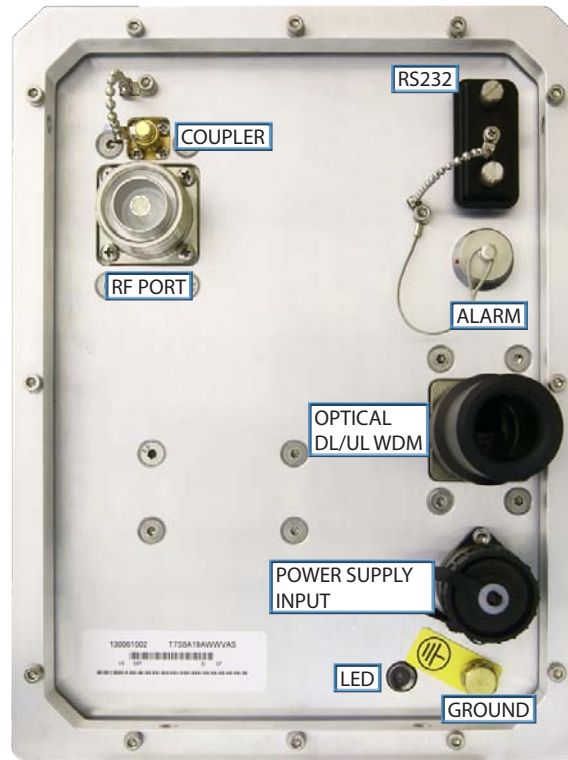
Very high power Remote Units and high power Remote Units
equipped with amplifiers operating in the LTE2600 band
Bottom view

REMOTE UNIT GENERAL OPERATING STATUS
LED DESCRIPTION (LED)

- Green: regular operation (no alarm)
- Blinking Orange: presence of active alarms with **warning** severity level
- Orange: presence of active alarms with **minor** severity level
- Blinking Red: presence of active alarms with **major** severity level
- Red: presence of active alarms with **critical** severity level

Label (Connectors)	Description
RF PORT	RF connector - 7/16 (f) type duplex
OPTICAL DL/UL WDM	Optical fiber input/output connector (laser aperture)
GROUND	Equipment grounding
POWER SUPPLY INPUT	AC voltage input (100-240Vac) DC voltage input (-72 ÷ -36Vdc)
FAN	Fans power supply and control connector
ALARM	Auxiliary alarms connector (4 in, 4 out)

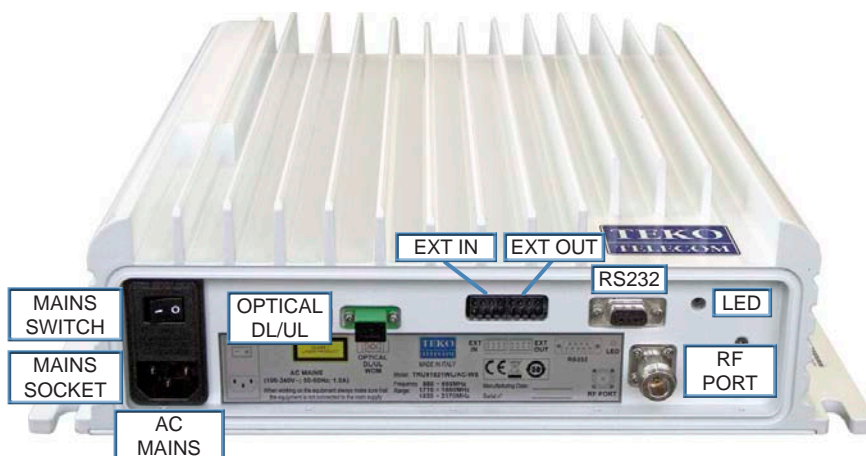
High and Very High Power Pole-mounting Remote Units External Access Points



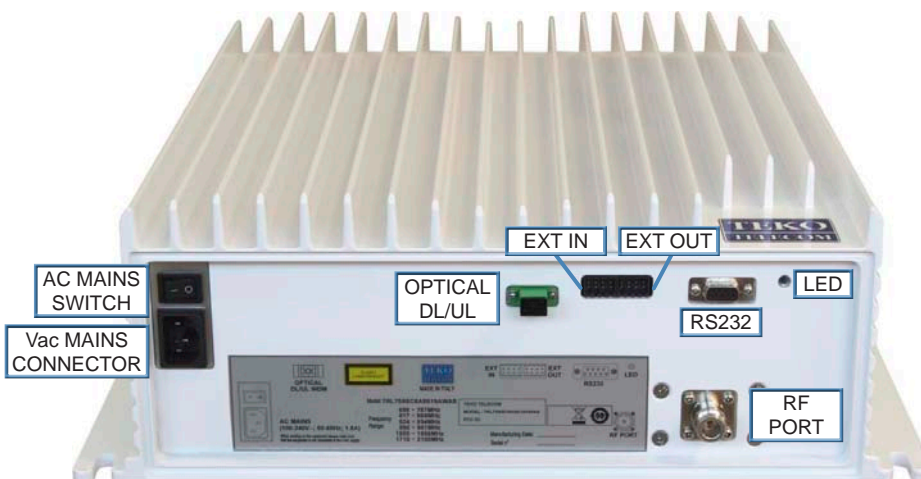
Pole mount Single band/multi-band High Power/ Very High power Wideband Remote Units - Bottom (Connector) view

Label (Connectors)	Description
RF PORT	RF connector - 7/16 (f) type duplex
COUPLER	Monitor port for measurements (Mobile Station side)
RS 232	Factory use only
OPTICAL DL/UL WDM	Optical fiber input/output connector (laser aperture)
GROUND	Equipment grounding
POWER SUPPLY INPUT	AC voltage input (100-240Vac) DC voltage input (-72 ÷ -36Vdc)
ALARM	Auxiliary alarms connector (4 in, 4 out)
LED	Remote Unit General Operating STATUS LED description Green: regular operation (no alarm) Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

Low Power Remote Units External Access Points (AC Powered)



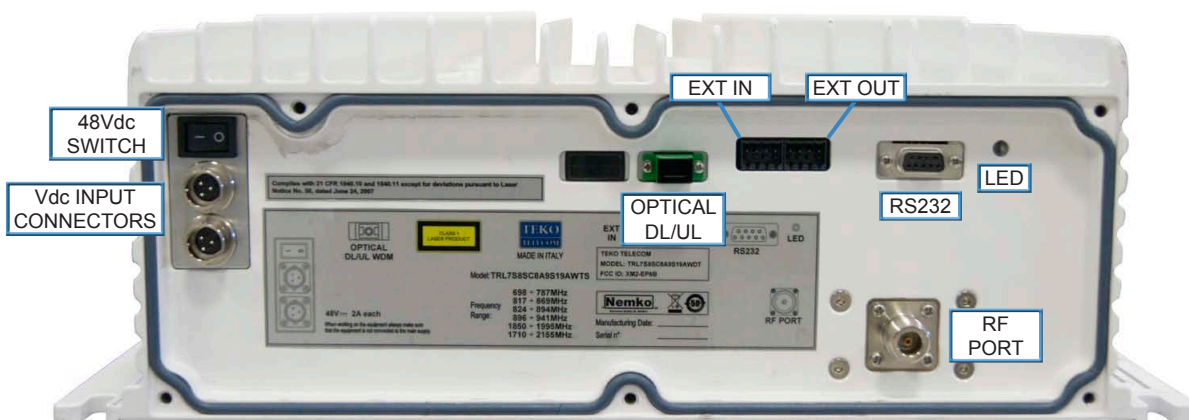
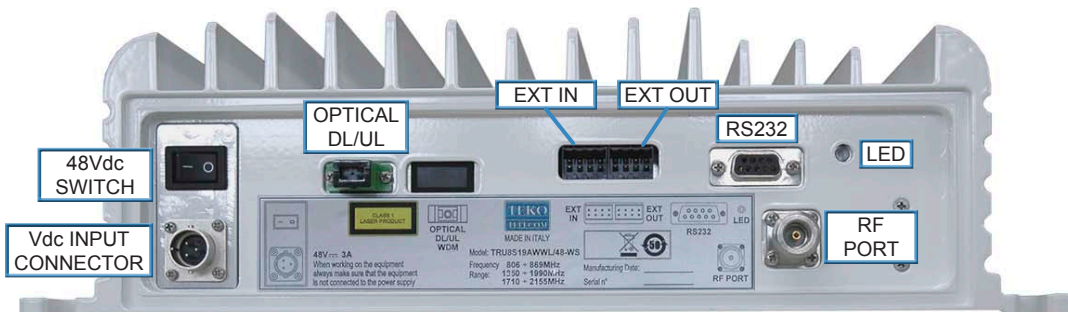
Single/Dual/Tri-Band Low Power Remote Units External Access Points



Six-Band Low Power Remote Unit External Access Points

Label (Connectors)	Description
RF PORT	RF connector - N (f) type duplex
OPTICAL DL/UL	Optical fiber input/output SC-APC connector (laser aperture)
AC MAINS	AC voltage input (100-240Vac) and switch
EXT OUT	External alarms output connector
EXT IN	External alarms input connector
RS 232	Factory use only
LED	Remote Unit general operating status LED Green: no alarm Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

DC Powered Low Power Remote Unit External Access Points



Label (Connectors)	Description
RF PORT	RF connector - N (f) type duplex
OPTICAL DL/UL	Optical fiber input/output SC-APC connector (laser aperture)
48V	Vdc input connector (48Vdc) and switch
EXT OUT	External alarms output connector
EXT IN	External alarms input connector
RS 232	Factory use only
LED	Remote Unit general operating status LED Green: no alarm Blinking Orange: presence of active alarms with warning severity level Orange: presence of active alarms with minor severity level Blinking Red: presence of active alarms with major severity level Red: presence of active alarms with critical severity level

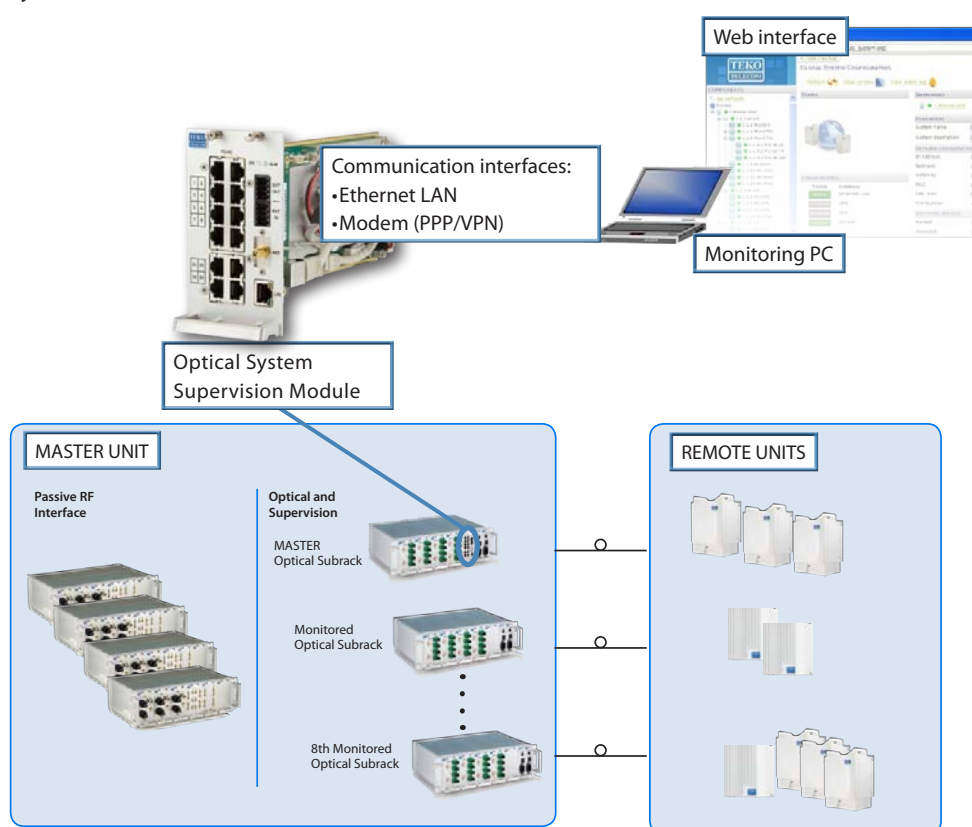
A.3.3 Coverage Systems Management and Power Supply

Coverage Systems can be accessed and managed simply connecting a PC, either locally or remotely, to the IP address of the System Supervision Module.

The management of the System is performed via Teko Telecom OMT 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.

Management Architecture

Teko Telecom Supervision Module (TSPV) allows the management of an entire Coverage and Capacity System.



The System Supervision Module is able to manage the Active Subrack it is equipped in (Master Subrack), the power supply subrack, up to other 12 Active Subracks (Monitored Subracks), and all connected Remote Units.

Twelve ports (1 to 8 and S1 to S4) are available on the Supervision Module front panel to be connected to the RS485 ports of monitored Active Subracks.

- **Ports numbered from 1 to 8**

The ports numbered from 1 to 8 are available for the connection to monitored subracks

mounted within the same rack hosting the Master Subrack.

- **Ports numbered from S1 to S4**

The other four ports (S1 to S4) are available for the management of remote active subracks equipped with Point to Point Slave modules.

The Slave Point to Point module installed on the left side of the remote slave subrack (slots 1 to 6) manages the remote optical subrack, the remote power supply subrack (if any), and all connected Remote Units. The Coverage System Supervision Module communicates with the Slave Point to Point built-in Supervision via the single-mode optical fiber (SMR 9/125), connecting Master and Slave Point to Point modules.

The ports S1 to S4 not connected to remote subracks can be used to manage additional subracks, mounted within the same rack hosting the Master Subrack.

- **Additional RS485 port available on the Master Subrack rear panel**

The RS485 connector, available on the rear panel of the SUB-TRX-PSU hosting the Supervision module, provides an additional port for the management of the power supply subrack (SUB-PSU-MU or SUB-PSU-MU/48). This port **is used only when the System is equipped with the power supply subrack in addition to other 12 monitored Active Subracks**, connected to the Supervision Module RS485 front ports.

- **RS485 port available on the Remote Subrack rear panel**

The RS485 port, available on the rear panel of a Remote Point to Point Slave Subrack, is used only when a SUB-PSU-MU or SUB-PSU-MU/48 is installed to provide power supply to the remote subracks.

Address assignment

Each monitored Subrack takes its address from the Supervision Module port it is connected to (please refer to Paragraph B.3.2 RS485 Connections for details).

The Active Subrack equipped with the Supervision Module (Master Subrack) takes address = 0 (zero).

- **Communication Interfaces**

The Supervision Module Communication Interfaces (Ethernet LAN port / Modem) allow the System to be managed either by a Local Maintenance Terminal (LMT), connected locally to the Supervision Module LAN port, or by a Network Element Manager (NEM).

The connection with a Network Element Manager (NEM) can be either a physical (Ethernet LAN) or a modem connection.

When a proprietary LAN/WAN Network supporting Ethernet is available, the System Supervision Module and the NEM exchange management and configuration information

across the LAN/WAN Network.

An optional wireless modem (GSM/GPRS or GSM/GPRS/UMTS), integrated inside the Supervision module, allows the Coverage System remote management. A VPN application installed on the Supervision Module provides remote and secure access to the System using the Internet.

An embedded SNMP agent software is available to provide a Northbound SNMP interface, allowing easy integration into upper level Network Management Systems (NMS).

Teko Telecom Operation and Maintenance Terminal (OMT) web pages show the Coverage System operating parameters and alarm status. They allow the commissioning, monitoring, setting and troubleshooting of the whole Coverage System.

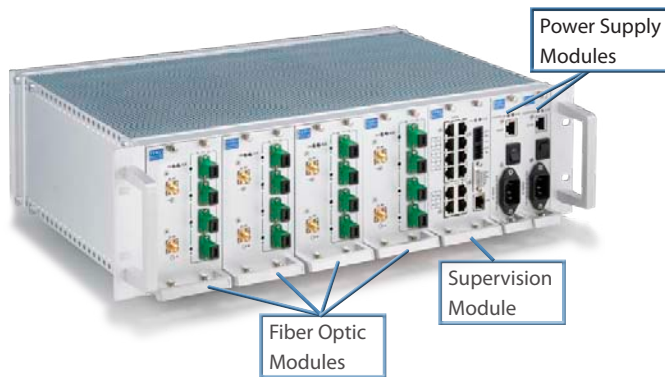
Teko Telecom Operation Management Centre (OMC) proprietary software allows the management of multiple Teko Telecom Coverage and Capacity Systems in a Network.

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

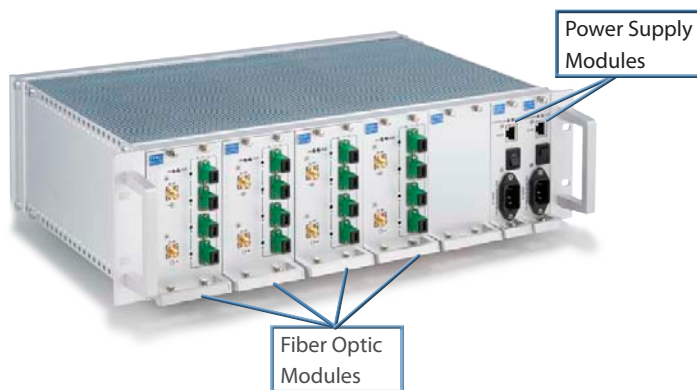
The Client provides access to the information stored in the Server database. It allows end-users to check the status of the Coverage Systems in the Network via a user friendly graphical interface.

Power Supply

Coverage Systems can be AC or DC powered. Power supply modules can be equipped in monitored Active Subracks or in the Master Subrack or in dedicated Active Subracks.



Example of Power Supply Modules equipped in the Master Optical Subrack (the second Power Supply Module, optional, provides power supply redundancy for higher reliability).



Example of Power Supply Modules equipped in a monitored Active Subrack. The RJ45 connector available on the Power Supply Module front panel can be used for connection to the Supervision Module, equipped in the Master Active Subrack.



Example of Power Supply Modules equipped in a dedicated Active Subrack.

Space efficient AC-to-DC and DC-to-DC Power Supply subracks are available to provide up to 2.4kW (AC/DC) / 3kW (DC/DC) maximum output power in just one height unit space.

A Power Supply distribution system is also available for the remote powering of Teko Telecom 48V_{DC} Low Power Remote Units.

Please refer to Paragraph A.2.6 for details.

A.3.4 Teko Telecom Coverage Systems Technical Specifications

Coverage and Capacity Systems mechanical, environmental and power supply specifications are available in the following tables. Please refer to Teko Telecom datasheets for detailed specifications. Contact Teko Telecom Sales Office for further information.

• Remote Units

Remote Unit model	Dimensions (HxWxD)	Weight	Operating temperature range	IP rating	Power supply
LOW POWER					
Single band Dual band Triband	355.5x350x100mm (14.00x13.78x3.94 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 DC version
5-US band 6-US band	414 x 414 x 144 mm (16.30 x 16.30 x 5.67in) max volume - heat sinks and connectors included	19 kg (41.9lbs)			
4-US band 4-EU band 5-EU band	395 x 414 x 144 mm (15.55 x 16.30 x 5.67in) max volume - heat sinks and connectors included	19 kg (41.9lbs)			
MEDIUM POWER					
Triband	570x415x260mm (22.44x16.34x10.24 in) max volume - heat sinks, handles and connectors included	30 kg (66.1 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66	85÷264Vac (50-60Hz) AC version -72÷-36Vdc DC version
Dual band		28 kg (61.73 lbs)			
Single band		26 kg (57.32 lbs)			
HIGH POWER					
Triband	570x415x260mm (22.44x16.34x10.24 in) max volume - heat sinks, handles and connectors included	32 kg (70.55 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66	85÷264Vac (50-60Hz) AC version -72÷-36Vdc DC version
Dual band		31 kg (68.34 lbs)			
Single band		28 kg (61.73 lbs)			
VERY HIGH POWER					
Triband	620x415x260mm (24.41x16.34x10.24 in) max volume - heat sinks, handles and connectors included	38 kg (83.78 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66	85÷264Vac (50-60Hz) AC version -72÷-36Vdc DC version
Dual band		37 kg (81.57 lbs)			
Single band		36 kg (79.37 lbs)			

• Pole Mounting Remote Units

Remote Unit model	Dimensions (HxWxD)	Weight	Operating temperature range	IP rating	Power supply
HIGH POWER / VERY HIGH POWER					
Up to 4-EU band Up to 5-US band	≈ 1047 x 183 x 256mm (41.22 x 7.20 x 10.08in) supports and connectors excluded	≈ 40kg (88.18lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66	85÷264Vac (50-60Hz) AC version -72÷-36Vdc DC version

• System Subracks

Subrack Commercial Code and Description	Dimensions	Operating Temperature Range
SUB-TRX-PSU Standard Active Subrack	19" - 3U depth 270mm (10.63in)	-5°C up to +55°C (+23°F up to +131°F) with proper forced-air cooling
SUB-HPOI Standard Passive Subrack	19" - 3U depth 270mm (10.63in)	-5°C up to +55°C (+23°F to +131°F)
SUB-TRX-PSU-D Deep Active Subrack, required to host fully equipped Digital Donor Front End modules	19" - 3U depth 360mm (14.17in)	-5°C up to +55°C (+23°F to +131°F)
TSFE Service Front End Subrack	19" - 2U depth 360mm (14.17 in)	-5°C up to +55°C (+23°F to +131°F)
TFAN-19-1U-4F-28V Forced-Air Cooling Subrack	19" - 1U depth 270mm (10.63in)	-5°C up to +55°C (+23°F to +131°F)

• Power Supply Components

Commercial Code and Description	Dimensions	Operating Temperature Range	Output Power
TPSU/AC AC/DC Power Supply Module	3U - 7TE	-5°C up to +55°C (+23°F to +131°F) with proper forced-air cooling	100W each, up to 2 in parallel 90W each, 3-4 in parallel 80W each, more than 4 in parallel
TPSU/48 DC/DC Power Supply Module			
SUB-PSU-MU AC/DC Power Supply Subrack (equipped with 1 to 3 TPSU/AC-30-1K, AC/DC Power Supply module)	19" - 1U, depth (handles included) 376mm (14.8in)	0°C up to +70°C (+32°F to +158°F) 50 to 60°C, derate 2% /°C; 60 to 70°C, derate 2.5% /°C	900W, each AC/DC Power Supply module 2430W, max configuration (3x TPSU/AC-30-1K)
SUB-PSU-MU/48 DC/DC Power Supply Subrack (equipped with 1 to 3 TPSU/48-30-1K, DC/DC Power Supply module)	19" - 1U, depth (handles included) 376mm (14.8in)	-5°C up to +55°C (+23°F to +131°F)	1kW each DC/DC Power Supply module

Commercial Code and Description	Dimensions	Operating Temperature Range	Output Power
SUB-RPSU2-MU/AC SUB-RPSU-MU/AC Power Supply distribution system for remote units (equipped with 1 to 4 TRPSU/AC-58-1.2K AC/DC Power Supply module)	19" - 2U, depth 421.5mm (16.59in) (handles and connectors included)	-5°C up to +55°C (+23°F to +131°F) with proper forced-air cooling	1.2kW @110-120Vac 1.9kW @200-270Vac each AC/DC Power Supply module
SUB-RPSU2-MU/48 and SUB-RPSU-MU/48 Power Supply distribution system for remote units (equipped with 1 to 4 TRPSU/48-58-2K DC/DC Power Supply Module)	19" - 2U, depth 421.5mm (16.59in) (handles and connectors included)	-5°C up to +55°C (+23°F to +131°F) with proper forced-air cooling	1.9kW each DC/DC Power Supply module