Optical Submarine Networks

Full Turnkey Solution

No Limits. No Boundaries.

Product Datasheet
Submarine Networks: Worldwide interconnection

Since the dawn of the telecommunications industry, Submarine network has played an essential role in ultra long-haul transmission, interconnecting continents and centers separated by sea.

The extensive development of transmission technology, along with improvements to deployment processes, resulted in high performance networks capable of ultimately contributing to global traffic transmission. It has therefore become a critical factor in the ability of businesses to stay competitive and maintain sustainability.

Although submarine networks typically have complex projects and a long period of deployment, the solution offers a higher transmission quality and reliability. It also allows for lower latency in comparison to other technologies.

**Padtec** is an integrated and worldwide supplier for Submarine Systems, providing not only transmission equipment based on DWDM technology, but also the entire optical infrastructure and project development.

Padtec is a full **Turnkey supplier** for submarine networks, offering an advanced and reliable solution recognized for its excellence and performance.

**Padtec** Submarine Solution is comprised by high capacity SLTE, Optical Cables, Branching Unit, Optical Repeater (OSLA) and a set of installation and OAM services.

The excellence present in **Padtec**’s solution along with a unique team expertise positions the company as an innovative and reliable partner to world telecommunication infrastructure.
The complete Submarine Solution allows high capacity optical transmission applied in repeatered and unrepeatered systems. Built to support severe environments, Padtec’s Dry Plant and Wet Plant equipment is entirely compatible to reliability requirements, being capable to guarantee system performance and robustness up to 25 years. In addition, Padtec’s set of services, including marine operation, contributes to a long-term and cost-effective operation.

In order to explore a wide range of submarine applications, Padtec covers new system deployment as well as seamless upgrades to existing systems, including alien wavelength scenario.

Padtec Submarine Solution is designed over a modular concept and allows optical transport achieving up to 120 Tbps combined capacity in a submarine cable with 6 fiber pairs. Due to robust high performance Wet Plant Equipment, this solution is capable of providing physical connectivity to centers as far as 10,000 km apart.

Padtec's entire Submarine Solution – from equipment to services – was conceived as a result of great effort in research and development, supplying operators with the latest generation optical transmission platform which enables sustainable growth, high scalability and competitiveness.

| Padtec Submarine Solution: No Limits. No Boundaries. |

- **Dry Plant**
  - High Capacity DWDM
  - Up to 200 channels
  - Coherent 40/100 Gbps
  - Raman/EDFA Amplifiers
  - Power Feeding Equipment
  - C-OTDR & Management

- **Wet Plant**
  - Submarine Optical Cable
  - High Reliability In Line Repeater (OSLA) with mechanic assembly and couplers suitable for high ocean depths
  - Passive / Active BU

- **Project & Service**
  - Design & Commissioning
  - Complete Survey
  - System Deployment, including Cable laying
  - All Marine Operations
  - Maintenance & Support

- **New Systems**
- **Capacity Upgrade**
- **Alien Wavelength**
  - Repeatered and Unrepeatered Solutions
The transmission equipment contained in the Padtec Submarine Solution was developed to support several applications from regional systems to ultra long-haul repeatered distances. Due to its integrated and modular design, Padtec’s transmission equipment is fully flexible according to system architecture with an excellent cost-benefit.
A Full Turnkey Supplier from new deployment to system upgrade

By taking advantage of its wide operation strategy, Padtec Submarine Solution is fully suitable for both new network deployment and existing system upgrades.

In this context, Padtec becomes a true partner in new optical systems due to a complete turnkey solution from network design to operation and maintenance. Padtec assures an impressive synergy and network consistency capable of enhancing deployment time and reducing Total Cost of Ownership (TCO).

For existing submarine systems characterized by lack of capacity, Padtec offers a flexible and seamless upgrade based on alien wavelength. This solution provides a cost-efficient alternative that leverages the entire wet plant structure while also protecting legacy investments.

New Optical Submarine System
- Full Turnkey Supplier:
  - High capacity and reliability DWDM
  - Network Project
  - DTS and Cable Route Survey
  - Deployment and Burial
  - Maintenance
  - General services
- Integration with terrestrial backbone

General Optical Submarine System Upgrade
- Alien wavelength environments
- Flexible and seamless upgrade
- High performance optical transponders (Coherent 100 Gbps and 40 Gbps)

- Required information:
  - Current supplier
  - Output power per channel
  - Receiving OSNR
  - Band guard between intensity and coherent channels
In order to enhance system capacity, modern optical submarine networks typically are based on DWDM technology.

To meet this need, Padtec offers a high capacity DWDM solution through the LightPad i6400G Platform. Developed over a modular and scalable architecture, the LightPad i6400G Platform offers a reliable optical transmission up to 20 Tbps per fiber pair in ultra long-haul distances.

**LightPad i6400G Platform for Submarine Network**

- Up to 200 channels at 10/40/100 Gbps
- 37.5 GHz Channel Spacing
- Coherent Detection: Enhanced tolerance against chromatic dispersion, BER and DGD
- Scalable deployment (seamless upgrade)
- Advanced amplification techniques (EDFA/Raman)
- Several protection mechanisms enabling optical link as well as equipment redundancy
- WSS ROADM is available for integration with terrestrial backbone and metro network
- High reliability and system robustness
- Compliant with standards and recommendations supporting multi-vendor environments
- Main client interfaces (flexible provisioning):
  - Fast Ethernet / 1 GbE / 10 GbE / 100 GbE
  - STM-1 to STM-256
  - Video Signals
  - OTN Signals
  - Others

**Dry Plant: DWDM SLTE - Submarine Line Terminal Equipment**
**Dry Plant: PFE for OSLA**

Long distance submarine networks, such as transoceanic transmission, typically need in line amplification across the bottom of the sea. In order to provide power supply to this submarine amplification equipment, external Power Feeding Equipment (PFE) is required. In association with a recognized partner, **Padtec** provides the entire PFE* infrastructure placed along with SLTE solution.

* Partnership with Third-party company

**Dry Plant: C-OTDR Supervision**

Performance and reliability are key factors for optical submarine transmission. In this context, the management and quick discovery of an eventual failure is critical to business competitiveness. In order to meet this requirement, **Padtec** offers a C-OTDR* capable of continuously monitoring the entire cable status and in line amplifiers.

The C-OTDR offered by **Padtec** is a solution provided by a trusted partner with years of knowledge and credibility in test equipment.

* High reliability
* 6/10/15 kV model
* Current and Voltage control
* Protected power supply (system architecture)

* Full submarine plant visibility
* Wet plant supervision for optical fault location
* Operates on line without impairing payload
* In service monitoring: entire optical cable, comprised by six internal fiber pairs
* C-OTDR is used for monitoring all the cable fibers and amplifiers
* Fully integrated to **Padtec**’s NMS

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* Partnership with Third-party company*
Transoceanic long-haul networks require submerged repeaters in order to guarantee system performance and connectivity. As submarine in line amplification is a critical component of a turnkey solution, great care must be taken in developing a robust amplifier which addresses the complex nature of both linear and non-linear effects on the light path whilst maximizing performance and usable spectrum on the line.

In order to meet this demand, Padtec offers a unique and reliable submarine repeater (OSLA – Optical Submarine Line Amplifier) based on EDFA technology. The submarine repeater provided by Padtec was developed to support severe environments and high depth pressure due to its advanced design.

Padtec’s optical repeater embeds 12 EDFAs with very low optical noise figure, allowing more than 10,000 km of submarine links.

**Main features:**
- Compact size: 1.8 x 0.275 m (with vessel)
- Internal EDFA: 12 amplifiers (6 fiber pairs)
- Maximum water depth: 8,000 m
- Working lifetime: 25 years
- Output Power: +15 dBm
- Noise Figure: 5 dB (maximum)
- Operating bandwidth: 69 nm
- Redundant pump laser
- State-of-the-art: Enhanced optical performance up to 200 x 37.5 GHz-spaced wavelengths on C+ and L Band
- Optimized power consumption and heat dissipation
- Robust electronic and optical projects with redundancy to all main parts
- Qualified assembly process
- C-OTDR supervision based system
- High tensile stress resistant splice
In order to provide the entire wet plant structure, Padtec offers ROC-2 Cable* for submarine ultra long-haul systems, supporting up to 8,000 m water depth while also inserting a low attenuation coefficient in optical system.

Padtec’s optical cable* for submarine application is comprised of six internal fiber pairs in addition to electrical connection for OSLA amplifiers.

Given varying ocean depths and seafloor conditions Padtec supports various cable types in order to ensure proper handling during deployment and protection for stable long term operation, for example via steel armored cable**.

- Internal fiber pairs: 6
- Composite Conductor: 1.0 Ω/km
- Insulation: 10 kV DC
- Cable Designs Qualified for Universal Joint (Certificates 200/488 – 200/500)

In order to enhance connectivity among centers and reduce CAPEX, undersea cables might interconnect more than two point-to-point stations, therefore, requiring a cable derivation.

Padtec offers active and passive Branching Units (BU) allowing high operation flexibility and reducing additional costs due to new cable deployments. Besides handling three submarine cables, Padtec’s solution provides connections at both optical (passive) and electrical (active) levels. Padtec’s BUs are compatible with submarine cables of all kinds – from the deep water lightweight cable to the shallow water armored submarine cable.

- Compact size: 1.4 m (L) x 0.330 m (Ø)
- Operation range: 0.2 to 1.6 A - 10 kV
- Fully configurable power path driven by PFE at terminal stations
- Each BU’s path is comprised by 6 fiber pairs
- Qualified lifetime: 25 years
- Internal OADM supported
- Dedicated sea earth electrode

* Partnership with Third-party company  ** Armoring will vary as per system design specifications.

Submarine Optical Cables

LW          LWP     SAL-R19       SA-R36      DA-R36/36

Padtec
Management resource controls

Due to the critical nature of the traffic provisioned on submarine systems a holistic management approach must be taken in order to allow carriers to quickly address issues that may affect system performance. Monitoring of the repeaters, terminals, PFE, as well as the optical line is paramount.

Padtec offers an integrated Network Management System (NMS) featuring innovative characteristics resulting in greater performance associated with significant cost reduction. Padtec Submarine Solution’s management is comprised of SLTE, PFE and C-OTDR full control, according to ITU-T international standards.

In order to offer an impressive flexibility besides cost optimization, the NMS provided by Padtec can easily be combined with terrestrial and aggregation network management. In addition, the NMS can be integrated with third-party systems through open interoperability protocols.

Main features:
- Types of management:
  - Fault
  - Configuration
  - Accounting
  - Performance
  - Security
- Remote or Local management
- Route, wavelength and service management (end-to-end)
- Integrates DWDM SLTE Equipment, Power Feeding Equipment and C-OTDR

Full Turnkey Supplier: Services for new deployment and system upgrades

Network Project
Project integration and Management
Land/Marine Survey
Route clearance
Documentation and authorizations
Infrastructure construction (SLTE, Cables, OSLAs,...)
Cable loading with Optical Amplifiers, BU and Joints
Full Wet Plant deployment
System commissioning and provisional acceptance
Acceptance & audits
Wet Plant maintenance definition and relevant contract
NOC & Customer Support (24x7)
Submarine Systems Maintenance

Padtec is committed to meeting the maintenance needs in submarine systems of its customers with agility and efficiency. To ensure this, Padtec has a highly specialized team for characteristics survey and study of each project peculiarities, enabling accurate performances that reach the objectives of each maintenance activity.

Currently, Padtec directly performs the maintenance services in wet plants of major operators, working under long-term contracts and covering all the Brazilian coast.

Padtec’s maintenance base for submarine systems is located in Aratú marine, near Salvador, Bahia, where a specialized and fully equipped ship is ready to proceed to repair campaigns. Concerned with the agility in providing services, Padtec also keeps a full warehouse dedicated to storing cables and joints spare kits.

Padtec has all the necessary human resources, including experts in optics and transmission systems, as well as materials prepared and qualified to perform Universal Quick Joints (UQJs), allowing agile interventions and the complete restoration of the systems at any point.
Padtec is a global manufacturer and solutions provider of turnkey optical solutions. The company offers products that span triple play edge boxes, equipment to empower fiber to the home or business, complete submarine solutions and long haul multi-terabit networks. Padtec takes you from your desktop to the world, with operations in North America, South America, Central America, Europe and Asia. The company, headquartered in Campinas, São Paulo Brazil, is the first and largest Latin American manufacturer of optical networking equipment. With a strong focus on research and development, Padtec develops custom solutions for global networks leveraging pioneering technology and robust mission critical support.

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