

# Tunable DWDM Transceiver - Official Technical Overview & Hardware Datasheet

## EXECUTIVE SUMMARY

As network operators contend with exponentially increasing bandwidth demands and the imperative for agile, high-capacity optical infrastructures, the requirement for advanced transceiver technology has never been more critical. The Tunable DWDM (Dense Wavelength Division Multiplexing) Transceiver represents a significant leap forward in optical networking, offering a versatile, future-proof solution that addresses the complexity of modern metro, regional, and long-haul networks. This document serves as the definitive technical overview and hardware datasheet for the platform, detailing its architecture, performance specifications, and strategic value for carrier-grade deployments.

Unlike fixed-wavelength optics, the Tunable DWDM Transceiver provides unparalleled operational flexibility, enabling network engineers to remotely provision wavelengths across the C-band. This capability eliminates the need for costly and logistically complex wavelength-specific inventory management and facilitates dynamic optical layer reconfiguration, essential for Software-Defined Networking (SDN) and automated network optimization. This application note provides a comprehensive analysis of the hardware, its optical performance, interoperability standards, and ordering logistics, establishing it as the reference document for procurement and engineering teams.



## ARCHITECTURE & CHASSIS DESIGN

The Tunable DWDM Transceiver is engineered as a hot-swappable, pluggable module adhering to the industry-standard Multi-Source Agreement (MSA) form factors. Available in QSFP-DD, QSFP28, and SFP-DD packages, the platform is designed for seamless integration into a wide array of networking equipment, including high-density routers, switches, and DWDM transport platforms. The physical architecture is a masterclass in optical and electronic integration, combining a precision micro-optics assembly for wavelength selection with a high-performance digital signal processor (DSP).

At the heart of the module is a tunable laser source capable of locking to any frequency within the full C-band (1528.77 nm to 1563.86 nm) in accordance

with the ITU-T G.694.1 wavelength grid. The transmitter assembly includes a high-power Mach-Zehnder Modulator (MZM) or Electro-absorption Modulated Laser (EML), ensuring high output power and low chirp for superior transmission distances. The receiver integrates a high-sensitivity avalanche photodiode (APD) or PIN photodiode, coupled with a low-noise transimpedance amplifier (TIA) to maximize the optical signal-to-noise ratio (OSNR) and link budget. The chassis design prioritizes thermal dissipation, utilizing advanced heat sink technology and a thermal-electric cooler (TEC) to maintain wavelength stability within  $\pm 2.5$  GHz, ensuring reliable operation across a wide temperature range and prolonged service life.

## HARDWARE FEATURES

The Tunable DWDM Transceiver is distinguished by a suite of sophisticated hardware features designed to maximize performance and reliability in demanding environments.

## HARDWARE FEATURES & CAPABILITIES

1. **DIGITAL DIAGNOSTIC MONITORING (DDM):** Integrated real-time monitoring of critical parameters, including supply voltage, temperature, laser bias current, and optical transmit/receive power, allows for proactive link health

assessment and granular performance management. This data is accessible via the I2C interface, aligning with SFF-8472 and CMIS standards.

2. **FULL C-BAND TUNABILITY:** Supporting up to 96 channels on the 50 GHz ITU grid, the transceiver offers full-rate tunability. The tunable laser architecture enables rapid wavelength switching, facilitating dynamic optical path provisioning and wavelength drift compensation, critical for reconfigurable optical add/drop multiplexer (ROADM)-based architectures.

3. **FLEXIBLE FEC SUPPORT:** The onboard DSP integrates a powerful Forward Error Correction (FEC) engine, supporting multiple key FEC algorithms. This includes support for pre-FEC BER estimation and post-FEC error counts, maximizing the transmission reach and system margin for high-bit-rate applications (e.g., 400ZR, 200G/400G).

4. **DUAL-COMPATIBILITY LINE INTERFACES:** Hardware configurable to support both 400G-ZR and 400G-ZR+ standards, enabling a graceful evolution to higher capacities. The line-side interface is designed with a high-performance driver and TIA to support both standard and enhanced optical modulation formats such as PCS-16QAM and PCS-64QAM.

## COMPLIANCE & STANDARDS

The transceiver has been subjected to rigorous testing and compliance validation to guarantee interoperability and adherence to the most demanding industry standards. It is certified as fully compliant with:

- ITU-T G.694.1: For DWDM frequency grid spacing.
- IEEE 802.3cu and 802.3df: Physical layer specifications for 100G and 400G Ethernet over DWDM.
- OIF 400ZR Implementation Agreement.
- GR-468-CORE: General reliability assurance requirements for optoelectronic devices.
- RoHS, REACH, and WEEE environmental compliance directives.
- ESD (Electrostatic Discharge) protection up to 2.5 kV Human Body Model (HBM).

## TECHNICAL SPECIFICATIONS

The following section provides the detailed technical specifications for the Tunable DWDM Transceiver, consolidating all critical performance parameters into a standardized matrix.

| Parameter | Specification |
|-----------|---------------|
|-----------|---------------|

|                                  |                                                         |
|----------------------------------|---------------------------------------------------------|
| Form Factor                      | QSFP-DD / QSFP28 / SFP-DD (MSA Compliant)               |
| Supported Data Rates             | 100G-DR, 100G-FR, 200G-DWDM, 400G-ZR, 400G-ZR+          |
| Wavelength Range (Tunable)       | Full C-Band (1528.77 nm - 1563.86 nm), 50 GHz Grid      |
| Channel Spacing                  | 50 GHz (0.4 nm)                                         |
| Max. Line Rate                   | Up to 400 Gbps                                          |
| Transmitter Type                 | Integrated Tunable Laser Assembly (ITLA) with MZM / EML |
| Receiver Type                    | APD / PIN + TIA                                         |
| Output Optical Power             | -10 dBm to +5 dBm                                       |
| Receiver Sensitivity             | -20 dBm (with FEC)                                      |
| Maximum Transmission Distance    | Up to 120 km (ZR+)                                      |
| FEC Support                      | OpenZR+, 15% SD-FEC, 20% SD-FEC                         |
| Power Consumption (Max)          | 18 W (QSFP-DD)                                          |
| Power Supply Voltage             | 3.3 V DC +/- 5%                                         |
| Environmental Operating Temp.    | 0°C to 70°C (Commercial) / -40°C to 85°C (Industrial)   |
| Optical Connector                | LC Duplex / MPO                                         |
| Digital Diagnostic Monitor (DDM) | Yes (I2C interface)                                     |

## ORDERING OPTIONS

To facilitate precise procurement aligned with specific network design requirements, the Tunable DWDM Transceiver is available under a systematic ordering code. This code structure ensures the delivery of the correct hardware configuration, minimizing the risk of compatibility issues.

