Coherent Optical Transceiver 400G ZR/ZR+ OSNR - Official Technical Overview & Hardware Datasheet

EXECUTIVE SUMMARY

The Coherent Optical Transceiver 400G ZR/ZR+ OSNR represents a paradigm shift in metro, regional, and data center interconnect (DCI) architectures, enabling the direct injection of 400 Gbps coherent wavelengths into router and switch ports without the need for external transponder shelves. By integrating advanced Digital Signal Processing (DSP), a tunable C-band laser, and a high-performance optical subassembly into a standardized hot-pluggable form factor (QSFP-DD or OSFP), this module delivers unprecedented spectral efficiency and operational simplicity. The critical performance differentiator for ZR+ operation in amplified, multi-span DWDM networks is the Optical Signal-to-Noise Ratio (OSNR) tolerance. Engineered to meet the stringent requirements of OpenZR+ MSA and OIF 400ZR implementation agreements, this transceiver maintains a robust link margin with a required OSNR (back-to-back, EOL) typically specified at 24 dB/0.1 nm for 400G DP-16QAM operation, ensuring reliable transmission over reaches extending to 600 km and beyond in ROADM-based line systems .



ARCHITECTURE & CHASSIS DESIGN

The transceiver is housed in a compact, hot-pluggable QSFP-DD (Type 2A) or OSFP form factor, designed for high-density line card configurations in modern telecom chassis. The internal architecture leverages a state-of-the-art 7 nm or 5 nm coherent DSP ASIC that performs complex modulation (DP-16QAM, DP-8QAM, DP-QPSK) and probabilistic constellation shaping (PCS) in ZR+ modes to maximize reach and capacity. The optical engine integrates a narrow-linewidth, full C-band tunable laser (ITU-T G.694.1 grid, 75/100 GHz spacing with flexible grid support) and a high-responsivity coherent receiver. Thermal management is a critical design pillar; the module features an integrated heatsink and advanced firmware-controlled power dissipation mechanisms to ensure stable operation within the 0 ° C to 70 ° C case temperature range, with typical power consumption ranging from <18 W in

standard ZR mode to approximately 22 W in high-performance ZR+ modes .

HARDWARE FEATURES

Key hardware capabilities include support for multiple client protocols and line rates, offering unparalleled flexibility. The module supports 400GbE, 300GbE, 200GbE, and 100GbE payloads, allowing network operators to trade capacity for reach dynamically. The transmitter delivers a configurable output power, with standard ZR variants operating around -10 dBm for amplified links, while ZR+ high-power variants provide up to 0 dBm output to overcome ROADM add/drop losses and facilitate multi-span traversal . The receiver exhibits high tolerance to optical impairments, including Chromatic Dispersion (CD) up to 20,000 ps/nm and Polarization Mode Dispersion (PMD) up to 20 ps, ensuring robust performance in deployed legacy fiber plants. Digital Optical Monitoring (DOM) and CMIS-compliant management interfaces provide real-time telemetry on OSNR, power levels, and laser bias, enabling proactive fault management .

COMPLIANCE & STANDARDS

The product is designed to be fully compliant with the OIF 400ZR Implementation Agreement (IA) and the OpenZR+ Multi-Source Agreement

(MSA) specifications, ensuring multi-vendor interoperability. It supports the IEEE 802.3bs 400GBASE-R PCS layer and utilizes a combination of Reed-Solomon (RS) and Staircase (SC) Forward Error Correction (FEC) coding to achieve a pre-FEC BER threshold that supports the stringent post-FEC error floor requirements (<1E-15). The module adheres to the QSFP-DD MSA and Common Management Interface Specification (CMIS) for host control, guaranteeing compatibility with a broad ecosystem of routing and switching platforms from major OEMs. Safety and environmental compliance includes RoHS and TAA where applicable .

TECHNICAL SPECIFICATIONS

The following table summarizes the key optical and electrical parameters that define the OSNR performance envelope and operational limits of the 400G ZR/ZR+ coherent transceiver.

Parameter	**Specification**
Form Factor	QSFP-DD (Type 2A) / OSFP, Hot-pluggable
Data Rate Support	400 Gbps / 300 Gbps / 200 Gbps / 100 Gbps (ZR+ Mode)
Modulation Format	DP-16QAM (400G), DP-8QAM (300G),

	DP-QPSK (200G/100G)
Transmit Output Power	ZR: -10 dBm (Typical) / ZR+: 0 dBm (High Power Option)
Receiver Sensitivity (OSNR)	24 dB / 0.1 nm (Back-to-Back, EOL, 400G ZR+)
OSNR Tolerance	Up to 22.7 dB (Typical ZR+ Link Budget)
Wavelength Range	Full C-band Tunable (191.3 THz – 196.1 THz)
Channel Spacing	75 GHz / 100 GHz (Flexible Grid Support)
Chromatic Dispersion Tolerance	Up to 20,000 ps/nm (ZR+ Mode)
Power Consumption	< 18 W (ZR Mode) / ~ 22 W (ZR+ Mode)
Operating Case Temperature	0°C to 70°C (Commercial) / -5°C to 80° C (Extended)
Management Interface	CMIS / C-CMIS Compliant, MDIO
Compliance	OIF 400ZR IA, OpenZR+ MSA, QSFP-DD MSA, RoHS

ORDERING OPTIONS

Available configurations include the standard 400G ZR (OIF compliant, -10 dBm Tx power, up to 120 km) and the enhanced 400G ZR+ (OpenZR+ compliant, high Tx power up to 0 dBm, extended reach up to 600+ km). Both variants are offered in QSFP-DD and OSFP form factors. Customers should specify the desired case temperature range (commercial 0°C to 70°C or extended -5°C to 80°C) and whether C-band tuning or specific grid spacing (75 GHz vs. 100 GHz) is required for their specific line system. For high-density DCI applications requiring maximum spectral efficiency without ROADM traversal, the standard ZR variant is optimal. For metro/regional deployments traversing multiple ROADM nodes and amplified spans, the ZR+ high-power variant with superior OSNR tolerance is recommended .

