How much light does a typical optical module in a data center output

Overview

OSFP Power Consumption by Data Rate: 400G to 1.6T GuideDifferent OSFP modules can vary dramatically in power draw depending on reach, modulation technology.

Key Takeaways

A typical optical module in a data center outputs light in the range of approximately -9 dBm to 0 dBm, depending on module type and fiber.Overview of Optical Power

The average transmit optical power of an optical module represents the light intensity emitted by the transmitter under normal operating conditions. It is usually measured in dBm (decibels relative to 1 milliwatt) or mW (milliwatts) and directly affects transmission distance, signal quality, and receiver performance . The power varies with the proportion of logical “1”s in the transmitted data, and the extinction ratio (difference between “1” and “0” light levels) influences signal clarity .

Typical Power Ranges
• SFP Modules (Small Form-factor Pluggable):
• Single-mode fiber (SMF): -9 dBm to -3 dBm

• Multi-mode fiber (MMF): -5 dBm to 0 dBm These ranges cover short-range and long-range applications commonly used in data centers .

• SFP+, SFP28, QSFP Modules:
• Modern high-speed modules (10 Gbps to 400 Gbps) generally fall within similar transmit power ranges, often around -3 dBm to 0 dBm for short-reach multi-mode links and slightly lower for long-reach single-mode links .

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Factors Affecting Output
• Fiber Type: Single-mode fibers require lower power for long distances, while multi-mode fibers may use higher power for short distances.

• Module Design: BiDi, CWDM, and DWDM modules may have slightly different output specifications.

• Data Pattern: The average power depends on the transmitted bit sequence; pseudo-random sequences are used for testing average output .

• Temperature and Voltage: Environmental conditions can slightly affect optical power.
Practical Implications
• Link Budget: The difference between transmit power and receiver sensitivity determines the maximum achievable distance without signal degradation.

• Signal Quality: Excessive power can damage receivers, while too low power may result in errors.

• Monitoring: Many modules support DDM/DOM to monitor real-time transmit power and ensure reliable operation . In summary, typical optical modules in data centers output light between -9 dBm and 0 dBm, with exact values depending on module type, fiber, and application, ensuring reliable high-speed data transmission over the intended distances .

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