

Actual Measurement of Optical Modules



Overview

Explore the working principles, performance indicators, and advantages of optical modules, with a focus on FS 25G modules.

Key Takeaways

Optical modules are measured by evaluating key performance indicators such as optical power, extinction ratio, wavelength, sensitivity, and latency using specialized instruments like Optical Spectrum Analyzers and diagnostic monitoring systems.

Key Performance Indicators

Transmitter Side Measurements:

- **Average Transmit Optical Power:** Measures the optical power output under normal operating conditions, expressed in Watts (W), milliwatts (mW), or decibels-milliwatts (dBm) ().
- **Extinction Ratio:** Ratio of the optical power for a full "1" signal to that of a full "0" signal, indicating the transmitter's ability to distinguish between logic levels, measured in dB ().
- **Center Wavelength:** The midpoint wavelength of the emission spectrum, typically in standard bands such as 850 nm, 1310 nm, or 1550 nm ().

Receiver Side Measurements:



- **Receiving Sensitivity:** Minimum optical power the receiver can detect reliably under a specific Bit Error Rate (BER), e.g., 10^{-12} ().
- **Overload Optical Power:** Maximum input optical power the receiver can handle without performance degradation ().

Latency and Timing Performance:

- **Tx and Rx Latency:** Measures the propagation delay of signals through the module, critical for high-speed PAM4 or coherent modules. Latency can be measured during Design Validation Testing (DVT) and may be compensated using EEPROM values ().
- **Total Latency:** Calculated as the sum of Tx and Rx delays, important for synchronization in time-sensitive networks ().

Measurement Tools and Techniques

- **Optical Spectrum Analyzer (OSA):** Used to measure wavelength, optical power, and signal-to-noise ratio (SNR), providing a spectral profile of the transmitted light ().
- **Digital Diagnostic Monitoring (DDM):** Enables real-time monitoring of parameters such as transmitted/received optical power, laser bias current, operating voltage, and temperature, following SFF-8472 standards ().
- **Photodetectors and Power Meters:** Measure optical power and extinction ratio directly at the transmitter or receiver interface ().
- **Bit Error Rate Testers (BERT):** Evaluate receiver sensitivity and overall module performance under specific data patterns and BER conditions ().

Practical Considerations

- Ensure proper calibration of instruments to maintain measurement accuracy.
- Use pseudo-random bit sequences to simulate realistic data traffic when measuring optical power and extinction ratio.
- For high-speed modules (25G, 50G, or higher), consider the impact of DSPs on latency and signal integrity ().
- Maintain clean optical interfaces to avoid measurement errors caused by dust or connector contamination ().

By systematically measuring these parameters, engineers can verify the reliability, efficiency, and compliance of optical modules in communication systems, ensuring optimal performance in both lab and field environments.

Article Content

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To meet these demanding measurement requirements, various measurement methods based on different physical

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Abstract: In order to test the accuracy of an optical measurement module, from the per-spective of practicability, this paper uses

Key Parameters Interpretation of Optical Modules

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Test transmitted power of optical modules using an optical power meter or DOM to ensure signal strength, network

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Therefore, we need to use a dispersion meter or dispersion software to measure the dispersion of the optical module

Understanding Optical Module Interconnection Principles

This article takes a deep dive into optical module interconnection from four dimensions — core principles, technical

Optical module

An optical module is a typically hot-pluggable optical transceiver used in high-bandwidth data communications applications. Optical

Explanation of Optical Module Parameters

In summary, we should select the appropriate optical module based on the actual usage scenario, including the

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For long-distance optical modules, since the average output optical power is generally greater than its maximum input optical power

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