

How to test the bandwidth of multimode fiber



Overview

The FOA Reference For Fiber Optics In order to test multimode fiber optic cables accurately and reproducibly, it is necessary to understand Multimode Optic.

Key Takeaways

Multimode fiber bandwidth testing is standardized through procedures like TIA/EIA-455-204, using both Overfilled Launch (OFL) and Restricted Mode Launch (RML) methods to characterize LED and VCSEL performance. Key Concepts in Multimode Fiber Bandwidth Testing

Modal Bandwidth (MBW) defines the information-carrying capacity of multimode fiber over a distance, expressed in MHz·km. It represents the frequency at which the optical power of a transmitted signal drops by 3 dB relative to a low-frequency reference, analogous to bandwidth measurements on an oscilloscope. MBW is influenced by the fiber type (OM1, OM2, OM3, OM4, OM5) and the light source used: LEDs typically produce an overfilled launch (OFL), while VCSELs produce an effective modal bandwidth (EMB) due to their narrower, more concentrated light output.

Standardized Test Procedures

- TIA/EIA-455-204 (FOTP-204): This standard specifies the measurement of the -3 dB bandwidth for multimode fibers, providing a repeatable method to determine modal bandwidth over a defined fiber length. It is applicable for both LED and laser sources, though results differ due to modal excitation differences.

- Overfilled Launch (OFL): Uses a wide-angle LED to excite all fiber modes, providing a conservative estimate of bandwidth suitable for legacy systems and general compliance testing .
- Restricted Mode Launch (RML): Developed to simulate VCSEL performance in laser-based networks, RML concentrates light into the fiber's central core, reducing modal dispersion and providing a more accurate prediction of high-speed link performance . RML testing is standardized in TIA/EIA-455-203 and correlates with real-world VCSEL-based LAN performance.
- Differential Mode Delay (DMD, FOTP-220): Measures the spread of arrival times of different modes, helping identify fibers with core imperfections or index profile issues that could limit high-speed performance .

Practical Considerations

- Fiber Type and Wavelength: OM1 and OM2 fibers are optimized for LED sources, while OM3, OM4, and OM5 are designed for VCSELs at 850 nm and, in the case of OM5, for multiple wavelengths using WDM . Testing must match the intended source type to avoid overestimating performance.
- Legacy Fiber Assessment: Bandwidth testing allows verification of installed fibers for higher-speed applications, such as 10 GbE or 100 GbE, without unnecessary replacement . A clean, smooth pulse in DMD or RML testing indicates good fiber, while irregular pulses suggest defects.
- Distance and Loss: Both modal bandwidth and fiber attenuation affect achievable link distances. Standards provide guidance on maximum distances for specific applications, considering both MBW and insertion loss .

Summary

Multimode fiber bandwidth testing relies on standardized procedures (FOTP-204, FOTP-203, FOTP-220) to measure modal bandwidth and predict system performance. OFL testing is suitable for LED-based systems, while RML testing is essential for VCSEL-based high-speed networks. Proper selection of test method, fiber type, and wavelength ensures accurate characterization and reliable network design .

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