

# A Simple Guide to Multimode Fibre, Sources, Measurements & Standards

## Application Note

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### Abbreviated Name Name

### Description

#### Measurements

OFL	Overfilled launch	The original standardised fibre bandwidth measurement where the source launches light uniformly into all modes of the multimode fibre. The launch condition of this measurement is similar to that of an LED source and hence this multimode fibre measurement gives a good indication of system performance when using legacy protocols utilising LED sources.
RML	Restricted Mode Launch	A standardised multimode fibre bandwidth measurement where the source launches light into a 23.5 µm spot in the centre of the multimode fibre. The launch condition of this measurement is similar to that of a 1 Gbps VCSEL source. Hence this multimode fibre measurement gives a good indication of system performance when using newly standardised, higher data rate protocols, with VCSEL Laser sources.
DMD	Differential Mode Delay	An alternative fibre measurement, which characterises the delay time of mode groups within a multimode fibre. This measurement methodology is used to modify the fibre index profile structure to improve Laser based system performance of a fibre.
DMD Masks	Differential Mode Delay Masks	The mask defines limits on the DMD measurements. Six of these masks have been defined in the IEEE 802.3ae draft standard. For a fibre to be compliant with the draft standard, it must meet one of these masks.
EF	Encircled Flux	A measurement to characterise the launch power distribution of a source.
EMB	Effective Modal Bandwidth	The bandwidth as seen in a system using a commercially available laser of known EF and also a fibre of known RML or DMD.

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## Fibre

n	Refractive index	
Sx	Short wavelength 850 nm	
Lx	Long wavelength 1300 nm	
OM-1	Draft ISO/IEC 11801 Edition 2 Fibre Classification	Specifies minimum OFL bandwidth 850 nm as 200 MHz.km, OFL bandwidth 1300 nm as 500 MHz.km
OM-2	Draft ISO/IEC 11801 Edition 2 Fibre Classification	Specifies minimum OFL bandwidth 850 nm as 500 MHz.km, OFL bandwidth 1300 nm as 500 MHz.km
OM-3	Draft ISO/IEC 11801 Edition 2 Fibre Classification	Specifies minimum OFL bandwidth 850 nm as 1500 MHz.km, OFL bandwidth 1300 nm as 500 MHz.km, & EMB 850 nm 2000 MHz.km

## Sources

LED	Light Emitting Diode	A light source that emits a large spot size of light, suitable for coupling into large core multimode fibres. These sources are data rate limited to 622 Mbps.
LASER	Light Amplification by Stimulated Emission of Radiation	A light source which emits a narrow spot of light. This light source also has a much narrower spectral wavelength in comparison to LEDs allowing it to modulate to very high data rates. Many different types of Lasers exist; common ones for use in LAN are VCSEL Lasers and Fabry Perot Lasers.
VCSEL	Vertical Cavity Surface Emitting Laser	A form of Laser made from semiconductor material, where the light is emitted from the surface of the semiconductor. This is a relatively new laser to the market. The 850 nm version of this laser has been in manufacture for several years and has been adopted in approximately 95% of Gigabit Ethernet applications.
FP Laser	Fabry Perot Laser	This is also a semiconductor Laser, differing from the VCSEL in that it is an edge-emitting device. Commonly used for 1300 nm/1310 nm applications for both single-mode and multimode fibre.
CWDM	Course Wavelength Division Multiplexing	A method of transmitting a number of channels down a fibre at once, each channel operating at a different wavelength so as not to interfere with each other. Four channels at the 1310 nm window are currently in the IEEE 802.3ae draft standard, each channel operating at 2.5 Gbps to provide the aggregate bandwidth of 10 Gbps.

## Standards

IEEE 802.3ae	International 10 Gigabit Ethernet Standard (Draft at the moment)	Ethernet Protocol transmitting at 10 Gigabits per second
IEEE 802.3z	International Gigabit Ethernet Standard	Ethernet Protocol transmitting at 1 Gigabit per second

## Application Space

LAN	Local Area Network	Provide interconnectivity of users and sharing of mainframe resources
SAN	Storage Area Network	Interconnection of storage servers & systems to host computers

## Protocols

10 Base-SX		Ethernet protocol operating 10 Mbps at 850 nm window
100 Base-LX		Ethernet protocol operating 100 Mbps at 1300 nm window
1000 Base-SX		Ethernet protocol operating 1 Gbps at 850 nm window
1000 Base-LX		Ethernet protocol operating 1 Gbps at 1300 nm window
10GBase-SR		Draft Ethernet protocol operating 10 Gbps at 850 nm window
10GBase-LX4		Draft Ethernet protocol operating 10 Gbps at 1300 nm window, using 4 channel CWDM

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