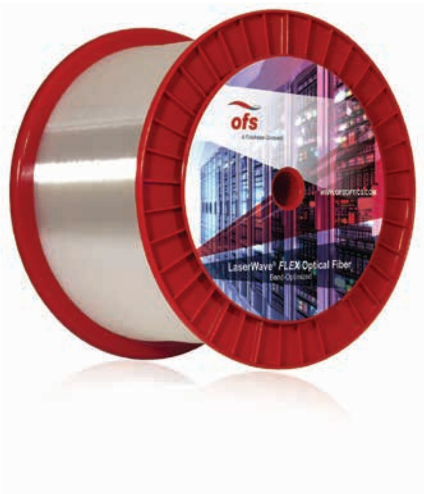
LaserWave® *FLEX* 300/550 (OM3/OM4) Optical Fiber

Optimized for outstanding performance in demanding data center and enterprise network applications



Features

- Designed for high speed, next generation enterprise and data center networks
- Enables minimal connection loss and low cabled attenuation
- Industry-leading fiber geometry and optical parameters.
- Exceeds IEC 60793-2-10 and ANSI/TIA 492AAAF standards for type A1-OM3 and A1-OM4 multimode fibers

Benefits

- Supports network speeds to 400 Gb/s and beyond
- Better macrobend performance enables better space utilization and more compact designs, while facilitating jumper MACs
- Supports added network flexibility and administration points

Now with even tighter specifications for lower connection loss!

Applications

- Data Centers
- High-performance Computing Centers
- Local Area Networks
- Storage Area Networks
- Central Offices

Overview

LaserWave® *FLEX* 300/550 (OM3/OM4) Fibers are 50 micron (µm) laser-optimized multimode fibers designed to support 10 Mb/s through 400 Gb/s applications in data centers, high performance computing centers and enterprise LANs with superior bending performance, enhancing fiber management and low-cost connectivity.

LaserWave Fiber extends the application of multimode fiber to support transmission speeds to 400 Gb/s and beyond. Using low-cost Vertical Cavity Surface Emitting Laser (VCSEL) transceivers, the fiber supports a wide variety of applications including Ethernet, Fibre Channel, InfiniBand and Optical Internetworking Forum (OIF) solutions.

Using state of the art process control, OFS LaserWave fiber is manufactured to the tightest geometry and optical specifications in the industry. Tighter specifications lead to lower variation when mating fibers in fiber optic connectors, and lower insertion loss. Today's high speed 100 and 400Gb/s applications have extremely low loss budgets, and low connector loss and fiber attenuation is key to supporting these links. The fiber offers extremely low bending loss at both the 850 and 1300 nm operating windows, while maintaining excellent long-term fiber strength and reliability. LaserWave *FLEX* Fiber can be installed in loops as small as 7.5 mm radius with less than 0.2 dB bending loss at 850 nm and 0.5 dB at 1300 nm. This improved performance can guard against instances of higher loss caused by tight bends, thereby increasing system reliability and maximizing network uptime.

FLEX-10® Coating
for Multimode Fibers

OFS multimode fibers are made with a world-class draw process and our enhanced Flex-10® Coating, designed to minimize induced attenuation that can occur in tight-buffer cable. Easy to strip and install, the coating offers outstanding performance in attenuation-sensitive systems up to 400 Gb/s.

Product Specifications		
Physical Characteristics		
Core Diameter	50 ± 2.5 µm	
Core Non-Circularity	≤ 2.5 %	
Clad Diameter	125 ± 0.7 µm	
Clad Non-Circularity	≤ 0.7 %	
Core/Clad Concentricity Error (Offset)	≤ 0.7 µm	
Coating Diameter	242 ± 5 µm	
Coating Non-Circularity	≤ 5 %	
Coating-Clad Concentricity Error (Offset)	≤ 10 µm	
Tensile Proof Test	100 kpsi (0.69 GPa)	
Coating Strip Force	Range: 0.22 - 2.0 lbf (1.0 - 8.9 N) Typical: 0.6 lbf (2.7 N)	
Standard Reel Lengths	Up to 17.6 km	
Optical Characteristics		
Attenuation		
at 850 nm	≤ 2.2 dB/km	
at 1300 nm	≤ 0.6 dB/km	
Laser Bandwidth/EMB	***See Transmission Characteristics Table***	
Transmission Distance (Link Length) Support	***See Applications Support Table***	
Attenuation at 1380 nm minus attenuation at 1300 nm	≤ 1.0 dB/km	
Attenuation Uniformity / Point Discontinuities at 850 nm and 1300 nm	≤ 0.08 dB	
Numerical Aperture	0.200 ± 0.010	
Chromatic Dispersion		
Zero Dispersion Wavelength(λ_0)	$1297 \leq \lambda_o \leq 1328$ nm	
Zero Dispersion Slope (S_0)	$S_0 \leq 4(-103)/(840(1-(\lambda_o/840)^4))$ ps/nm².km	
Group Refractive Index		
at 850 nm	1.483	
at 1300 nm	1.479	
Backscatter Coefficient		
at 850 nm	-68.4 dB	
at 1300 nm	-75.8 dB	
Macrobend Attenuation	850 nm	1300 nm
100 turns @ 37.5 mm radius	≤ 0.5 dB	≤ 0.5 dB
2 turns @ 15 mm radius	≤ 0.1 dB	≤ 0.3 dB
2 turns @ 7.5 mm radius	≤ 0.2 dB	≤ 0.5 dB
Environmental Characteristics		
Operating Temperature Range	-60° C to +85° C	
Temperature Induced Attenuation at 850 nm and 1300 nm from -60° C to +85° C (5 24-hour cycles)	≤ 0.1 dB/km	
Temperature and Humidity Induced Attenuation at 850 nm and 1300 nm from -10° C to +85° C, 94% RH (30 24-hour cycles)	≤ 0.1 dB/km	
Accelerated Aging (Temperature) Induced Attenuation at 85° C for 30 days	≤ 0.1 dB/km	
Water Immersion Induced Attenuation, 23° C for 30 days	≤ 0.1 dB/km	
Damp Heat, 85° C, 85% Relative Humidity for 30 days	≤ 0.1 dB/km	
Dynamic Fatigue Stress Corrosion Parameter typical (n_d)	≥ 20	

Transmission Characteristics		
Minimum Bandwidth Specifications (MHz-km)		
	LaserWave *FLEX* 550 (OM4) Fiber	**LaserWave *FLEX* 300 (OM3) Fiber**
Laser EMB @ 850 nm[1]	4700	2000
Laser EMB @ 1300 nm	500	500
Overfilled @ 850 nm	3500	1500
Overfilled @ 1300 nm	500	500

[1] Effective Modal Bandwidth, per ANSI/TIA 492AAAFand IEC 60793-2-10, ensured by EMBc and DMD performance specifications for sources meeting the launch conditions specified in applicable IEEE Ethernet, Fibre Channel, and OIF standards. LaserWave *FLEX* OM4/OM3 Fiber meets the specification requirements of both the EMBc and the more discriminating DMD mask methods.

DMD Specifications (ps/m maximum)

The fiber shall meet at least one of the following DMD templates, each of which consists of both an inner and outer mask specification, and the sliding mask specifications shown below.

The requirements for **LaserWave *FLEX* 300 (OM3) Fiber** are compliant with, but more stringent than the requirements of ANSI/TIA 492AAAF Type A1-OM3 and IEC 60793-2-10 Type A1-OM3.

Template Number	850 nm DMD-Inner Mask (ps/m) (Radius 0-18 μm) [2, 3]	850 nm DMD-Outer Mask (ps/m) (Radius 0-23 μm) [3]
1	≤ 0.23	≤ 0.70
2	≤ 0.24	≤ 0.60
3	≤ 0.25	≤ 0.50
4	≤ 0.26	≤ 0.40
5	≤ 0.27	≤ 0.35
6	≤ 0.33	≤ 0.33

Sliding Interval Masks: ≤ 0.25 ps/m

The requirements for **LaserWave *FLEX* 550 (OM4) Fiber** are compliant with, but more stringent than, the requirements of ANSI/TIA 492AAAF Type A1-OM4 and IEC 60793-2-10 Type A1-OM4.

Template Number	850 nm DMD-Inner Mask (ps/m) (Radius 0-18 μm) [2, 3]	850 nm DMD-Outer Mask (ps/m) (Radius 0-23 μm) [3]
1	≤ 0.10	≤ 0.30
2	≤ 0.11	≤ 0.17
3	≤ 0.14	≤ 0.14

Sliding Interval Masks: ≤ 0.11 ps/m

[2] OFS Inner Mask Radial specification is more stringent than the ANSI/TIA 492AAAF and IEC 60793-2-10 requirement of 5-18 μm.
[3] OFS DMD measurement scanning steps are 1 μm, twice as stringent as the maximum 2 μm steps required by the standards.

For more information on DMD, visit our website at www.ofsoptics.com and download our white paper, *Measuring Bandwidth of High-Speed Multimode Fiber*.

Manufacturing and Quality Control

LaserWave *FLEX* OM4 and OM3 Fiber provides improved performance above the minimum required by the standards. OFS' advanced MCVD process used to manufacture LaserWave *FLEX* Fibers eliminates the center defect problems that can plague fibers manufactured with other processes. The Inner DMD mask for LaserWave *FLEX* Fiber is expanded to a range from 0 to 18 μm radius versus the less stringent 5 to 18 μm radius allowed by TIA and IEC.

This reduces fundamental and very low-order mode DMD for improved operating margin and superior support of concentrated center-launch lasers. This results in LaserWave *FLEX* Fiber DMD up to 60% better than what the standard allows in the center portion of the fiber and improves system reliability margins versus other DMD controlled fibers.

LaserWave *FLEX* Fiber meets and exceeds the specification requirements of both the EMBc and the more discriminating DMD mask methods for verifying Effective Modal Bandwidth. Both techniques are recognized and approved industry standards; however the DMD mask method allows for closer scrutiny of fiber characteristics, enabling LaserWave *FLEX* to be specified to more stringent DMD specifications than required by the standards. This provides increased performance and reliability for your network.

OFS LaserWave *FLEX* Fiber specifications exceed the reliability requirement of the IEEE Ethernet standards, providing assurance for 100% functional system reliability.

For additional information please contact your sales representative.

You can also visit our website at www.ofsoptics.com or call 1-888-fiberhelp (1-888-342-3743) USA or 1-770-798-5555 outside the USA.

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Applications Support

Application Support Examples Distance (Meters)[1]

	LaserWave *FLEX* 550 (OM4) Fibers	**LaserWave *FLEX* 300 (OM3) Fibers**
400 Gigabit Ethernet		
850/910 nm (400GBASE-SR4.2)	100	70
850 nm (400GBASE-SR8)	100	70
100 Gigabit Ethernet		
850 nm (100GBASE-SR10)	190 [2]	140 [2]
850 nm (100GBASE-SR4)	100	70
850/910 nm (100Gb/s BiDi)	100	70
850-940 nm (100Gb/s SWDM4)	100	75
40 Gigabit Ethernet		
850 nm (40GBASE-SR4)	190 [2]	140 [2]
850/910 nm (40Gb/s BiDi)	100	70
850-940 (40Gb/s SWDM4)	350	240
10 Gigabit Ethernet		
850 nm (10GBASE-S)	550 [3]	300
1310 nm CWDM lasers (10GBASE-LX4)	300	300
1310 serial w/ EDC (10GBASE-LRM)	220	220
1 Gigabit Ethernet		
850 nm (1000BASE-SX)	1040	1000 [4]
1310 nm (1000BASE-LX)	600	600

[1] Unless otherwise indicated, application support distances are based on standard total connection plus splice loss of 1.5 dB and cable attenuations of 3.5/1.5 dB/km at 850 nm and 1300 nm respectively. Lower-loss connectors and lower cable attenuations can lead to longer supportable distances. Contact OFS for specific cable attenuation and connection plus splice loss necessary to support a target distance.

[2] Distances assume maximum 1.0 dB total splice/connector loss, maximum 3.0 dB/km cable attenuation at 850 nm, and VCSEL spectral width of ≤ 0.45 nm. 100 meter reach over OM3 and 150 meter reach over OM4 as defined by IEEE 802.3ba.

[3] 550 meter reach assuming 3.5 dB/km maximum cabled attenuation at 850 nm plus 1.0 dB of total connection and splice loss, or 3.0 dB maximum cabled attenuation at 850 nm and 1.3 dB total connection and splice loss. 400 meter reach as defined by IEEE 802.3ae.

[4] 1000-meter reach assuming total connection plus splice loss of 0.9 dB.