



The Fibreoptic Industry Association

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## OPTICAL FIBRE CABLING AND DATA NETWORKS

### SUMMARY APPLICATION NOTE: DAN001

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The following information is taken from EN 50173-1:2010 (incorporating the changes and updates applied during the production of Amendment 2 of EN 50173-1:2007). As such the information represents the single most comprehensive summary of the demands placed by data (local area networks) on installed optical fibre cabling infrastructure. It is not intended to be used in place of the standards or without an understanding of the terms used in the tables (as is provided in the FIA Technical Support document TSD-2000-1-1: *LAN Application Support Guide*).

The main Table 2 and Table 3 below contain the maximum channel insertion losses (CIL) and lengths specified in their respective application standards for most of the commonly used applications. They are also mapped on to the generic optical fibre cabling channel Classes of EN 50173-1 and ISO/IEC 11801. It is not necessary to consider the latter but they are explained, for completeness, in Table 1.

#### Generic optical fibre cabling channel Classes

Standards produced by CENELEC TC215 (i.e. the EN 50173 series) and ISO/IEC JTC1 SC25 WG3 (e.g. ISO/IEC 11801) use a Class system of defining "envelopes" of optical fibre cabling channel performance. For cabled all-silica optical fibre Categories OM1, OM2, OM3 and OM4 (for multimode) and OS1 and OS2 (for singlemode) the specifications for the Classes are shown in Table 1.

Table 1 - Specifications of optical fibre cabling channel Class

Class	Cabled optical fibre Category	Maximum channel attenuation dB			
		Multimode		Singlemode	
		850 nm	1300 nm	1310 nm	1550 nm
OF-100	OM1, OM2, OM3, OM4	1,85	1,65	-	-
OF-300	OM1, OM2, OM3, OM4, OS1, OS2	2,55	1,95	1,80	1,80
OF-500	OM1, OM2, OM3, OM4, OS1, OS2	3,25	2,25	2,00	2,00
OF-2000	OM1, OM2, OM3, OM4, OS1, OS2	8,50	4,50	3,50	3,50
OF-5000	OS1, OS2	-	-	4,00	4,00
OF-10000	OS1, OS2	-	-	6,00	6,00

The channel specifications are hierarchical for a given modal system (i.e. multimode or singlemode). That is to say, an OF-100 channel will support the applications specified to operate over a OF-300 channel.

When looking at Table 2 or Table 3, the relevant Class indicated for the cabled optical fibre Category means that it **AT LEAST** operates over the channel length and channel attenuation dictated in Table 1. However, it will operate over the full length and channel insertion loss described in Table 2 or Table 3.

Table 2 - Specifications of MMF applications

Network Application	$\lambda$ nm	Core dia $\mu$ m	OM1			OM2			OM3/OM4		
			CIL <sup>a</sup> dB	L <sup>b</sup> m	Class	CIL <sup>a</sup> dB	L <sup>b</sup> m	Class	CIL <sup>a</sup> dB	L <sup>b</sup> m	Class
IEEE 802-3: FOIRL	850	50	3,3	514	OF-500	3,3	514	OF-500	3,3	514	OF-500
		62,5	9,0	1 000	OF-500	9,0	1 000	OF-500	-	-	-
IEEE 802-3: 10GBASE-FL, FP & FB	850	50	6,8	1 514	OF-500	6,8	1 514	OF-500	6,8	1 514	OF-500
		62,5	12,5	2 000	OF-2000	12,5	2 000	OF-2000	-	-	-
ISO/IEC TR 11802-4: Token Ring (4 and 16 Mbit/s)	850	50	8,0	1 857	OF-500	8,0	1 857	OF-500	8,0	1 857	OF-500
		62,5	13,0	2 000	OF-2000	13,0	2 000	OF-2000	-	-	-
ATM at 51,84 Mbit/s	1 300	50	5,3	2 000	OF-2000	5,3	2 000	OF-2000	5,3	2 000	OF-2000
		62,5	10,0	2 000	OF-2000	10,0	2 000	OF-2000	-	-	-
ATM at 155,52 Mbit/s	850	50	7,2	1 000	OF-500	7,2	1 000	OF-500	7,2	1 000	OF-500
		62,5	7,2	1 000	OF-500	7,2	1 000	OF-500	-	-	-
	1 300	50	5,3	2 000	OF-2000	5,3	2 000	OF-2000	5,3	2 000	OF-2000
		62,5	10,0	2 000	OF-2000	10,0	2 000	OF-2000	-	-	-
ATM at 622,08 Mbit/s <sup>c</sup>	850	50	4,0	300	OF-300	4,0	300	OF-300	4,0	300	OF-300
		62,5	4,0	300	OF-300	4,0	300	OF-300	-	-	-
	1 300	50	2,0	330	OF-300	2,0	330	OF-300	2,0	330	OF-300
		62,5	6,0	500	OF-500	6,0	500	OF-500	-	-	-
DIS 14165-111: Fibre Channel (FC-PH) at 133 Mbit/s	1 300	50	-	-	-	-	-	-	-	-	-
		62,5	6,0	1 500	OF-500	6,0	1 500	OF-500	6,0	1500	OF-500
DIS 14165-111: Fibre Channel (FC-PH) at 266 Mbit/s	850	50	12,0	2 000	OF-2000	12,0	2 000	OF-2000	12,0	2 000	OF-2000
		62,5	12,0	700	OF-500	12,0	700	OF-500	-	-	-
	1 300	50	5,5	2 000	OF-2000	5,5	2 000	OF-2000	5,5	2 000	OF-2000
		62,5	6,0	1 500	OF-500	6,0	1 500	OF-500	-	-	-
DIS 14165-111: Fibre Channel (FC-PH) at 531 Mbit/s	850	50	8,0	1 000	OF-500	8,0	1 000	OF-500	8,0	1 000	OF-500
		62,5	8,0	350	OF-300	8,0	350	OF-300	-	-	-
DIS 14165-111: Fibre Channel (FC-PH) at 1062 Mbit/s <sup>c</sup>	850	50	4,0	500	OF-500	4,0	500	OF-500	4,0	500	OF-500
		62,5	4,0	300	OF-300	4,0	300	OF-300	-	-	-
1 Gbps FC (1,0625 GBd) <sup>c</sup>	850	50	-	-	-	3,85	500	OF-500	2,62	500	OF-500
		62,5	3,0	300	OF-300	-	-	-	-	-	-
2 Gbps FC (2,125 GBd) <sup>c</sup>	850	50	2,10	150	OF-100	2,62	300	OF-300	3,31	300	OF-300
4 Gbps FC (4,25 GBd) <sup>c</sup>	850	50	-	-	-	2,06	150	OF-100	2,88 <sup>d</sup>	380 <sup>d</sup>	OF-300
		-	-	-	-	-	-	-	3,02 <sup>e</sup>	420 <sup>e</sup>	OF-300
8 Gbps FC (8,5 GBd) <sup>c</sup>	850	50	-	-	-	1,68	50	-	2,19 <sup>d</sup>	150 <sup>d</sup>	OF-100
		-	-	-	-	-	-	-	2,22 <sup>e</sup>	190 <sup>e</sup>	OF-100
16 Gbps FC (14,025 GBd) <sup>c</sup>	850	50	-	-	-	1,63	35	-	1,95 <sup>d</sup>	100 <sup>d</sup>	OF-100
		-	-	-	-	-	-	-	1,97 <sup>e</sup>	125 <sup>e</sup>	OF-100
		-	-	-	-	-	-	-	-	-	-
IEEE 802-3: 1000BASE-SX <sup>c</sup>	850	50	-	-	-	3,56	550	OF-500	3,56	550	OF-500
		62,5	2,6	275	OF-100	-	-	-	-	-	-
IEEE 802-3: 1000BASE-LX <sup>c</sup>	1 300	50	2,35	550	OF-500	2,35	550	OF-500	2,35	550	OF-500
		62,5	2,35	550	OF-500	2,35	550	OF-500	-	-	-
EN ISO/IEC 9314-3: FDDI PMD	1 300	50	6,3	2 000	OF-2000	6,3	2 000	OF-2000	6,3	2 000	OF-2000
		62,5	11,0	2 000	OF-2000	11,0	2 000	OF-2000	-	-	-
ISO/IEC 8802-3: 100BASE-FX	1 300	50	6,3	2 000	OF-2000	6,3	2 000	OF-2000	6,3	2 000	OF-2000
		62,5	11,0	2 000	OF-2000	11,0	2 000	OF-2000	-	-	-
IEEE 802.3: 10GBASE-SR/SW	850	50	-	-	-	1,80	82	-	2,60	300	OF-300
		62,5	1,60	32	-	-	-	-	-	-	-
IEEE 802.3: 10GBASE-LX4 <sup>c</sup>	1 300	50	2,0	300	OF-300	2,0	300	OF-300	2,0	300	OF-300
		62,5	2,0	300	OF-300	2,0	300	OF-300	-	-	-
IEEE 802.3: 40GBASE-SR4 <sup>c</sup>	850	50 <sup>d</sup>	-	-	-	-	-	-	1,90 <sup>d</sup>	100 <sup>d</sup>	OF-100
		50 <sup>e</sup>	-	-	-	-	-	-	1,50 <sup>f</sup>	150 <sup>f</sup>	OF-100
IEEE 802.3: 100GBASE-SR10 <sup>c</sup>	850	50 <sup>d</sup>	-	-	-	-	-	-	1,90 <sup>d</sup>	100 <sup>d</sup>	OF-100
		50 <sup>e</sup>	-	-	-	-	-	-	1,50 <sup>f</sup>	150 <sup>f</sup>	OF-100

<sup>a</sup> CIL is the maximum channel insertion loss (or optical power budget, as applicable) as defined in the application standard.

<sup>b</sup> L is the lower of:  
the maximum channel length specified in the application standard;  
a calculated length from the CIL with 1,5 dB allocated to connecting hardware.

<sup>c</sup> A bandwidth limited application at the channel length shown. The use of lower attenuation components to produce channels exceeding the length shown cannot be recommended.

<sup>d</sup> for cabled optical fibre of Category OM3.

<sup>e</sup> for cabled optical fibre of Category OM4.

<sup>f</sup> for cabled optical fibre of Category OM4 (subject to a maximum total connecting hardware loss of 1,0dB).

Table 3 - Specifications of SMF applications

Network Application	$\lambda$ nm	OS1			OS2		
		CIL <sup>a</sup> dB	L <sup>b</sup> m	Class	CIL <sup>a</sup> dB	L <sup>b</sup> m	Class
ATM at 51,84 Mbit/s	1 310	10,0	2 000	OF-2000	10,0	20 000	OF-10000
ATM at 155,52 Mbit/s	1 310	7,0	2 000	OF-2000	7,0	12 500	OF-10000
ATM at 622,08 Mbit/s	1 310	7,0	2 000	OF-2000	7,0	12 500	OF-10000
DIS 14165-111: Fibre Channel (FC-PH) at 266 Mbit/s	1 310	6,0	2 000	OF-2000	6,0	10 000	OF-10000
DIS 14165-111: Fibre Channel (FC-PH) at 531 Mbit/s	1 310	14,0	2 000	OF-2000	14,0	30 000	OF-10000
DIS 14165-111: Fibre Channel (FC-PH) at 1062 Mbit/s	1 310	6,0	2 000	OF-2000	6,0	10 000	OF-10000
1 Gbps FC (1,0625 GBd) <sup>c</sup>	1 310	7,8	5 800	OF-2000	7,8	10 000	OF-10000
2 Gbps FC (2,125 GBd) <sup>c</sup>	1 310	7,8	5 800	OF-2000	7,8	10 000	OF-10000
4 Gbps FC (4,25 GBd) <sup>c</sup>	1 310	7,8	2 800	OF-2000	7,8	10 000	OF-2000
8 Gbps FC (8,5 GBd) <sup>c</sup>	1 310	6,4	4 400	OF-2000	7,8	10 000	OF-10000
16 Gbps FC (14,025 GBd)	1 310	6,4	4 400	OF-2000	7,8	10 000	OF-10000
IEEE 802-3ae: 1000BASE-LX <sup>c</sup>	1 310	4,56	2 560	OF-2000	4,56	5 000	OF-5000
ISO/IEC 9314-4: FDDI SMF-PMD <sup>c</sup>	1 310	10,0	2 000	OF-2000	10,0	20 000	OF-10000
IEEE 802.3: 10GBASE-LX4 <sup>c</sup>	1 310	6,2	4 200	OF-2000	6,2	10 000	OF-10000
IEEE 802.3: 10GBASE-LR/LW <sup>c</sup>	1 310	6,2	4 200	OF-2000	6,2	10 000	OF-10000
IEEE 802.3: 10GBASE-ER/EW <sup>c</sup>	1 550	10,9	8 900	OF-2000	10,9	22 250	OF-10000
IEEE 802.3: 40GBASE-LR4 <sup>c</sup>	1 310	6,7	4 700	OF-2000	6,7	10 000	OF-10000
IEEE 802.3: 100GBASE-LR4 <sup>c</sup>	1 310	8,3	8 300	OF-2000	8,3	10 000	OF-10000
IEEE 802.3: 100GBASE-ER4 <sup>c</sup>	1 550	18,0	16 000	OF-2000	18,0	40 000	OF-10000

<sup>a</sup> CIL is the maximum channel insertion loss (or optical power budget, as applicable) as defined in the application standard.

<sup>b</sup> L is the lower of:

the maximum channel length specified in the application standard;  
a calculated length from the CIL with 2,0 dB allocated to connecting hardware.

<sup>c</sup> A bandwidth limited application at the channel length shown. The use of lower attenuation components to produce channels exceeding the length shown cannot be recommended.