



The Fibreoptic Industry Association

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Secretary: Jane Morrison

The Manor House  
BUNTINGFORD  
Hertfordshire SG9 9AB  
United Kingdom

Tel: +44 (0) 1763 273039 Fax: +44 (0) 1763 273255

e-mail: [jane@fiasec.demon.co.uk](mailto:jane@fiasec.demon.co.uk)

## MODIFIED BANDWIDTH SPECIFICATIONS FOR OM3 AND OM4

by

Mike Gilmore, Technical Director

The Category OM3 of cabled multimode optical fibre has been in existence since 2001 and Category OM4 is being promoted by suppliers on a global basis. However, OM4 is not yet within a published standard and the efforts to produce the required support standards have identified an issue in relation to bandwidth measurement which impacts the way in which both OM3 and OM4 are specified. This could be a source of some confusion and this White Paper is aimed to explain the change and thereby head off some of that confusion.

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The key differentiating parameter for OM3 and OM4 is the bandwidth they provide to sources with restricted launch conditions i.e. lasers and VCSELs. Category OM3 was developed to provide the VCSEL-based 10GBASE-SR (10 Gigabit Ethernet operating at 850 nm) application with a transmission distance of at least 300 metres. In order to support this objective, IEC 60793-1-49:2006 (also published as a BS EN) was created to enable to measurement of differential mode delay (DMD) as a means of defining the required bandwidth performance.

However, DMD does not provide a direct bandwidth measurement - instead it defines limits for the maximum delay (in ps/m) between different mode groups within the optical fibre. The actual DMD and any resulting calculated bandwidth for a given type of optical source depends on the actual mode groups that it excites within that optical fibre. Using devices in accordance with the IEEE specification for 10GBASE-SR, the minimum modal bandwidth was determined to be 2000 MHz.km. For this reason the original requirements for OM3 were specified in both BS EN 50173-1:2002 and ISO/IEC 11801:2002 as shown below.

Category	Nominal core diameter $\mu\text{m}$	Minimum modal bandwidth MHz $\times$ km		
		Overfilled launch bandwidth		Effective laser launch bandwidth
		850 nm	1 300 nm	850 nm
OM3	50	1 500	500	2 000
NOTE Effective laser launch bandwidth is assured using DMD as specified in IEC (or BS EN) 60793-1-49.				

The first product reference for the optical fibre used to create cabled optical fibre of Category OM3 was defined in IEC (also BS EN) 60793-2-10:2004 as optical fibre Type A1a.2. Two equivalent parameters could be used to provide conformance to the requirements for the "minimum effective modal bandwidth-length product" of 2000 MHz.km. One was "DMD" and other was "calculated effective modal bandwidth (EMB<sub>c</sub>)" but they continued to define the optical source as meeting the requirements of the IEEE specification for the 10GBASE-SR VCSEL. This approach was maintained in IEC (also BS EN) 60793-2-10:2007.

Category OM3 cabled optical fibre is also the primary medium for the delivery of 40 Gigabit and 100 Gigabit Ethernet over distances of 100 metres. In addition, Category OM4 is being promoted as being able to extend this distance to 125 metres. To add to this mix, other applications such as FibreChannel are keen to exploit the opportunities offered by the higher Category products.

As a result, ISO/IEC 11801, EN 50173-1 and IEC 60793-2-10 are all being revised to support cabled optical fibres of Category OM4. The requirements of OM4 are to be defined in ISO/IEC 11801 Ed2.2 (expected to be approved in Q2, 2010) as shown below.

Category	Nominal core diameter $\mu\text{m}$	Minimum modal bandwidth MHz $\times$ km		
		Overfilled launch bandwidth		Effective modal bandwidth
		850 nm	1 300 nm	850 nm
OM3	50	1 500	500	2 000
OM4	50	3 500	500	4 700
NOTE Modal bandwidth requirements apply to the optical fibre used to produce the relevant cabled optical fibre category and are assured by the parameters and test methods specified in IEC 60793-2-10.				

The note under the table indicates that the reference for modal bandwidth performance has changed from IEC 60793-1-49 to IEC 60793-2-10. To support this cross-reference IEC 60793-2-10 is also being revised (expected to be approved in Q2, 2010) to include a specification for a Type A1a.3 optical fibre to enable the construction of the Category OM4 cabled optical fibre. However, this revision of IEC 60793-2-10 includes a fundamental re-think of the specification of effective modal bandwidth. This could lead to confusion and this White Paper has been produced to highlight and resolve that confusion.

IEC 60793-2-10 continues to apply the two equivalent approaches - "DMD" and "EMB<sub>C</sub>" but now makes the requirement independent of the optical source by creating a "standard" launch condition template. The potential confusion comes from the fact the new standard template does not provide values of 2000 MHz.km and 4700 MHz.km as shown in the table above for Categories OM3 and OM4 cabled optical fibres respectively - instead the revised EMB<sub>C</sub> limits equate to values of 1770 MHz.km and 4160 MHz.km. Optical fibres meeting these requirements under the standard launch condition template are expected to provide effective modal bandwidths of 2000 MHz.km and 4700 MHz.km when used with the 850 nm VCSELs specified by IEEE for 10Gb/s, 40 Gb/s and 100 Gb/s Ethernet applications.

As can be seen in the table above, the draft of ISO/IEC 11801 Ed2 Amendment 2 indicates the "IEEE source"-based values in order to provide continuity with earlier versions of the standard – whilst directing the reader to the IEC 60793-2-10 for the detail.

However, in order to be technically accurate and not to quote figures for effective modal bandwidth which may not be appropriate for optical sources in future applications, the amendment to BS EN 50173-1 (expected to be approved in Q3, 2010) may well adopt a slightly different approach as shown below.

Category	Nominal core diameter $\mu\text{m}$	Minimum modal bandwidth MHz $\times$ km		
		Overfilled launch bandwidth		Application-specific bandwidth <sup>1</sup>
		850 nm	1 300 nm	850 nm
OM3	50	1 500	500	2000
OM4	50	3 500	500	4700
NOTE Modal bandwidth requirements apply to the optical fibre used to produce the relevant cabled optical fibre category and are assured by the parameters and test methods specified in EN 60793-2-10.				
1 this bandwidth is based on application-specific implementation of the EMB <sub>C</sub> requirements of EN 60793-2-10.				

It is important to understand that although the measurement methods and calculated limits for effective modal bandwidth are changing, producing different limits for those parameters, there is no change to previously compliant products or the distances over which they may be used for the applications that are operated over them.

The information in this White Paper, as with all other FIA White Papers, will be updated as all the above mentioned amendments and revisions to standards progress towards final approval and publication.

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