IEC 60793-1-48

Edition 3.0 2017-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Optical fibres –
Part 1-48: Measurement methods and test procedures – Polarization mode dispersion

Fibres optiques –
Partie 1-48: Méthodes de mesure et procédures d’essai – Dispersion de mode de polarisation

IEC 60793-1-48:2017-08(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTENTS

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OPTICAL FIBRES –

Part 1-48: Measurement methods and test procedures – Polarization mode dispersion

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60793-1-48 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition published in 2007. It constitutes a technical revision. This edition includes the following significant technical change with respect to the previous edition:

a) removal of the SOP approach.

The text of this standard is based on the following documents:

CDV	Report on voting
86A/1678/CDV	86A/1766/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard is to be read in conjunction with IEC 60793-1-1:2008. A list of all parts in the IEC 60793 series, published under the general title *Optical fibres,* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Polarization mode dispersion (PMD) causes an optical pulse to spread in the time domain. This dispersion could impair the performance of a telecommunications system. The effect can be related to differential phase and group velocities and corresponding arrival times $\delta\tau$ of different polarization components of the signal. For a sufficiently narrow band source, the effect can be related to a differential group delay (DGD), $\Delta\tau$, between pairs of orthogonally polarized principal states of polarization (PSP) at a given wavelength. For broadband transmission, the delays bifurcate and result in an output pulse that is spread out in the time domain. In this case, the spreading can be related to the average of DGD values.

In long fibre spans, DGD is random in both time and wavelength since it depends on the details of the birefringence along the entire fibre length. It is also sensitive to time-dependent temperature and mechanical perturbations on the fibre. For this reason, a useful way to characterize PMD in long fibres is in terms of an average DGD value over an appropriately large optical frequency range, either RMS $\langle\Delta\tau\rangle$, the rms DGD over this frequency range, or MEAN $\langle\Delta\tau\rangle$, the (linear) mean of the DGD over this same frequency range. In principle, the average DGD value (RMS $\langle\Delta\tau\rangle$ or MEAN $\langle\Delta\tau\rangle$) does not undergo large changes for a given fibre from day to day or from source to source, unlike the parameters $\delta\tau$ or $\Delta\tau$. In addition, the average DGD value is a useful predictor of lightwave system performance.

The term "PMD" is used both in the general sense of two polarization modes having different group velocities, and in the specific sense of the average DGD value (RMS $\langle\Delta\tau\rangle$ or MEAN $\langle\Delta\tau\rangle$). Although the DGD $\Delta\tau$ or pulse broadening $\Delta\delta$ is preferably averaged over frequency, for certain situations it may be averaged over time, or temperature.

The coupling length l_c is the length of fibre or cable at which appreciable coupling between the two polarization states begins to occur. If the fibre length L satisfies the condition $L \ll l_c$, mode coupling is negligible, and $\langle\Delta\tau\rangle$ scales with fibre length. The corresponding PMD coefficient is

$$\text{short-length PMD coefficient} = \langle\Delta\tau\rangle / L.$$

Fibres in practical systems nearly always have fibre lengths much greater than the coupling length and random mode coupling. When mode coupling is random, $\langle\Delta\tau\rangle$ scales with the square root of fibre length, and

$$\text{long-length PMD coefficient} = \langle\Delta\tau\rangle / \sqrt{L}\ .$$

OPTICAL FIBRES –

Part 1-48: Measurement methods and test procedures – Polarization mode dispersion

1 Scope

This part of IEC 60793 applies to three methods of measuring polarization mode dispersion (PMD), which are described in Clause 4. It establishes uniform requirements for measuring the PMD of single-mode optical fibre, thereby assisting in the inspection of fibres and cables for commercial purposes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60793-1-1, *Optical fibres - Part 1-1: Measurement methods and test procedures - General and guidance*

IEC TR 61292-5, *Optical amplifiers - Part 5: Polarization mode dispersion parameter - General information*

ITU-T Recommendation G.650.2, *Definitions and test methods for statistical and non-linear related attributes of single-mode fibre and cable*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ITU-T Recommendation G.650.2 apply.

NOTE Further explanation of their use in this document is provided in IEC TR 61282-9.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Symbols and abbreviated terms

Arg	Argument function
ASE	Amplified spontaneous emission
BBS	Broadband source
CFT	Cosine Fourier transform
c/c_0	Velocity of light in vacuum/in free space
DGD	Differential group delay
DGD_{max}	Maximum DGD value