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Fibre optic communication system design guidelines – Part 14: Determination of the uncertainties of attenuation measurements in fibre plants

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIBRE OPTIC COMMUNICATION SYSTEM DESIGN GUIDELINES –

Part 14: Determination of the uncertainties of attenuation measurements in fibre plants

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC TR 61282-14:2019. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC TR 61282-14 has been prepared by 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is a Technical Report.

This document contains an attached file in the form of an Excel spreadsheet. This file is intended to be used as a complement and does not form an integral part of the document.

This third edition cancels and replaces the second edition published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of uncertainties calculation for optical time domain reflectometer (OTDR) measurement methods based on the analysis provided in 61280-4-3;
b) addition of uncertainties calculation for passive optical networks (PON);
c) update of the list of reference grade connectors;
d) addition of probability distribution in Table D.1.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
86C/1913/DTR	86C/1923/RVDTR

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

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61282 series, published under the general title *Fibre optic communication system design guidelines,* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

~~The determination of the uncertainty of every measurement is a key activity, which should be performed by applying dedicated methods as extensively presented in reference documents such as ISO/IEC Guide 98-3:2008, *Guide to the uncertainty of measurement (GUM)*.~~

~~This document shows a practical application of these methods for the determination of the measurement uncertainty of the attenuation of fibre optic cabling using optical light sources and power meters as defined in IEC 61280-4-1 and IEC 61280-4-2.~~

Reference documents such as ISO/IEC Guide 98-3, *Guide to the uncertainty of measurement (GUM)*, detail methods for the determination of the uncertainty of a measurement.

This document shows a practical application of these methods for the determination of the uncertainty in attenuation measurements of fibre optic cabling as defined in IEC 61280-4-1, IEC 61280-4-2, and IEC 61280-4-3, using optical light sources and power meters or OTDRs, with the exception of multimode OTDRs.

It includes the review of all contributing factors to uncertainty (such as launch conditions, spectral width, stability of source, power meter polarization, resolution, linearity, and quality of test cord connectors) to determine the overall measurement uncertainty. This part of IEC 61282 applies to the measurement of single-mode or multimode fibres without restrictions to the fibre parameters, including mode field diameter, core diameter, and NA. However, numerical values given in Clause C.2 and typical values given in Annex D are not valid for multimode fibres types A2, A3, and A4.

The list of uncertainties presented in this document is related to this particular application and ~~should be reconsidered if~~ measurement conditions that are ~~not~~ compliant with measurement requirements defined by IEC 61280-4-1, IEC 61280-4-2, and IEC 61280-4-3.

The reference document for general uncertainty calculations is ISO/IEC Guide 98-3~~:2008~~, and this document does not intend to replace it. This document only presents examples, and ~~should be used~~ it is good practice to use it in conjunction with ISO/IEC Guide 98-3~~:2008~~. A brief introduction to the determination of measurement uncertainty according to ISO/IEC Guide 98-3~~:2008~~ is given in Annex A.

This document is associated with a calculation spreadsheet (Excel) containing practical calculations.

FIBRE OPTIC COMMUNICATION SYSTEM DESIGN GUIDELINES –

Part 14: Determination of the uncertainties of attenuation measurements in fibre plants

1 Scope

This part of IEC 61282, which is a Technical Report, establishes a detailed analysis and calculations of the uncertainties related to the measurement of the attenuation of both multimode and single-mode optical fibre cabling, using optical light sources and power meters. It also includes simplified analysis and calculation of the uncertainties related to the measurement of the attenuation of single-mode optical fibre cabling using OTDRs.

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 61280-4-1:2009, *Fibre-optic communication subsystem test procedures – Part 4-1: Installed cable plant – Multimode attenuation measurement*~~

~~IEC 61280-4-2:2014, *Fibre-optic communication subsystem test procedures – Part 4-2: Installed cable plant – Single-mode attenuation and optical return loss measurement*~~

~~ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement* (GUM:1995)~~

There are no normative references in this document.

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TECHNICAL REPORT

Fibre optic communication system design guidelines – Part 14: Determination of the uncertainties of attenuation measurements in fibre plants



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INTRODUCTION

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This document shows a practical application of these methods for the determination of the uncertainty in attenuation measurements of fibre optic cabling as defined in IEC 61280-4-1, IEC 61280-4-2, and IEC 61280-4-3, using optical light sources and power meters or OTDRs, with the exception of multimode OTDRs.

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The list of uncertainties presented in this document is related to this particular application and measurement conditions that are compliant with measurement requirements defined by IEC 61280-4-1, IEC 61280-4-2, and IEC 61280-4-3.

The reference document for general uncertainty calculations is ISO/IEC Guide 98-3, and this document does not intend to replace it. This document only presents examples, and it is good practice to use it in conjunction with ISO/IEC Guide 98-3. A brief introduction to the determination of measurement uncertainty according to ISO/IEC Guide 98-3 is given in Annex A.

This document is associated with a calculation spreadsheet (Excel) containing practical calculations.

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Part 14: Determination of the uncertainties of attenuation measurements in fibre plants

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