IEC 62129-3

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Calibration of wavelength / optical frequency measurement instruments – Part 3: Optical frequency meters internally referenced to a frequency comb

Étalonnage des appareils de mesure de longueur d'onde / appareil de mesure de la fréquence optique – Partie 3: Fréquencemètres optiques ayant référence en interne à un peigne de fréquence

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FOREWORD

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International Standard IEC 62129-3 has been prepared by IEC technical committee 86: Fibre optics.

This first edition cancels and replaces IEC TS 62129-3, published in 2014.

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

a) text has been added to 5.2.3 about calibration at a second optical frequency;
b) Annex D is now normative;
c) Subclause 4.2 has been improved;
d) measurement method of frequency has been moved to Annex B;
e) example of optical frequency comb has been moved to Annex C;
f) frequency-dependence uncertainty has been moved to Annex D.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
86/551/FDIS	86/554/RVD

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

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

A list of all parts in the IEC 62129 series, published under the general title *Calibration of wavelength/optical frequency measurement instruments*, 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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INTRODUCTION

It is essential for realizing fibre optic systems that optical channels are defined in the optical frequency domain, not the wavelength domain. One example: the anchor frequency of the ITU-T grid is 193,1 THz, and the channel spacings of the ITU-T grid are 12,5 GHz, 25 GHz, 50 GHz, and 100 GHz [1][1].

ITU-T has also discussed λ-interface systems such as "black link" [2]. "Black link" includes WDM MUX/DEMUX and a transmission fibre, and provides λ-interfaces. Especially in DWDM systems (channel spacing < 100 GHz), the uncertainty in specifying optical frequency needs to be minimized.

To implement future telecom systems, it is expected that optical frequency measurements will need to be extremely precise. For example, to achieve the channel spacing of 25 GHz, signal optical frequency uncertainty (Uf_{sig}) and required measurement uncertainty (Uf_{meas}) need to be 2 GHz to 200 MHz (Uf_{sig}/f = 10^{-5} to 10^{-6}) and 200 MHz to 2 MHz (Uf_{meas}/f = 10^{-6} to 10^{-8}), respectively. Unfortunately, conventional wavelength meters have measurement uncertainties of 10^{-6} to 10^{-7}. The solution is to use optical frequency measurements since measurement uncertainties can be as small as 10^{-9}, which satisfies the above telecom requirement (Uf_{meas}/f = 10^{-6} to 10^{-8}). Therefore, an optical frequency measurement scheme is necessary for the calibration of future telecom systems.

The frequency meter to calibrate with the procedure described in this document is the measurement equipment internally utilizing the optical frequency comb. In Annex A, the mathematical basis for the uncertainty of measurement is described. The measurement procedure of the frequency with the frequency meter utilizing the optical frequency comb is shown in Annex B and the example of the optical frequency comb sources are shown in Annex C. Additionally, the uncertainty depending on the frequency is shown in Annex D.

This document defines all the steps involved in the calibration process of the frequency measuring with the optical frequency meter internally utilizing an optical frequency comb: establishing the calibration conditions, carrying out the calibration, calculating the uncertainty, and reporting the uncertainty, the calibration conditions and the traceability.

[1] Numbers in square brackets refer to the Bibliography.

CALIBRATION OF WAVELENGTH / OPTICAL FREQUENCY MEASUREMENT INSTRUMENTS –

Part 3: Optical frequency meters internally referenced to a frequency comb

1 Scope

This part of IEC 62129 describes the calibration of optical frequency meters using an optical frequency comb as an internal reference. It is applicable to instruments measuring the optical frequency emitted from sources that are typical for the fibre-optic communications industry. It is assumed that the optical radiation will be coupled to the optical frequency meter by a single-mode optical fibre. This document is part of the IEC 62129 series on the calibration of wavelength/optical frequency measurement instruments. Refer to IEC 62129-1 [3] for the calibration of optical spectrum analyzers, and refer to IEC 62129-2 [4] for calibration of Michelson interferometer single wavelength meters.

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 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

IEC TR 61931, *Fibre optic – Terminology*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TR 61931, and the following apply.

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

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