Fibre optic communication subsystem test procedures - Part 2-9: Digital systems -Optical signal-to-noise ratio measurementfor dense wavelength-division multiplexed systems

EESTI STANDARDIKESKUS
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EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
Käesolev Eesti standard EVS-EN 61280-2-9:2009 sisaldab Euroopa standardi EN 61280-2-9:2009 ingliskeelset teksti.	This Estonian standard EVS-EN 61280-2-9:2009 consists of the English text of the European standard EN 61280-2-9:2009.
Standard on kinnitatud Eesti Standardikeskuse 30.06.2009 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.	This standard is ratified with the order of Estonian Centre for Standardisation dated 30.06.2009 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.
Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 22.04.2009.	Date of Availability of the European standard text 22.04.2009.
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English version

Fibre optic communication subsystem test procedures - Part 2-9: Digital systems - Optical signal-to-noise ratio measurement for dense wavelength-division multiplexed systems
(IEC 61280-2-9:2009)

Procédures d'essai des sous-systèmes de télécommunications à fibres optiques - Partie 2-9: Systèmes numériques - Mesure du rapport signal sur bruit optique pour les systèmes multiplexés à répartition en longueur d'onde dense (CEI 61280-2-9:2009)

Prüfverfahren für Lichtwellenleiter-Kommunikationsuntersysteme - Teil 2-9: Digitale Systeme - Messung des optischen Signal-Rausch-Verhältnisses für dichte Wellenlängen-Multiplex-Systeme (IEC 61280-2-9:2009)

This European Standard was approved by CENELEC on 2009-04-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization

Comité Européen de Normalisation Electrotechnique

Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 61280-2-9:2009 E

Foreword

The text of document 86C/823/CDV, future edition 2 of IEC 61280-2-9, prepared by SC 86C, Fibre optic systems and active devices, of IEC TC 86, Fibre optics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61280-2-9 on 2009-04-01.

This European Standard supersedes EN 61280-2-9:2002.

The main changes from EN 61280-2-9:2002 are as follows:

– a paragraph has been added to the scope describing the limitations due to signal spectral width and wavelength filtering;

– Annex B has been added to further explain error in measuring noise level due to signal spectral width and wavelength filtering.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-01-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-04-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61280-2-9:2009 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 61290-3-1	-[1)]	Optical amplifiers - Test methods - Part 3-1: Noise figure parameters - Optical spectrum analyzer method	EN 61290-3-1	2003[2)]
IEC 62129	-[1)]	Calibration of optical spectrum analyzers	EN 62129 + corr. December	2006[2)] 2006

[1)] Undated reference.

[2)] Valid edition at date of issue.

CONTENTS

INTRODUCTION

At the optical interfaces within wavelength-division multiplexed (WDM) networks, it is desirable to measure parameters that provide information about the integrity of the physical plant. Such parameters are necessary to *monito*r network performance as an integral part of network management. They are also necessary to assure proper system operation for *installation and maintenance* of the network.

Ideally, such parameters would directly correspond to the bit error ratio (BER) of each channel of a multichannel carrier at the particular optical interface. Related parameters such as Q-factor or those calculated from optical eye patterns would provide similar information, that is, they would correlate to the channel BER. However, it is difficult to obtain access to these parameters at a multichannel interface point. It is necessary to demultiplex the potentially large number of channels and make BER, Q-factor, or eye-diagram measurements on a per-channel basis.

In contrast, useful information about the optical properties of the multichannel carrier is readily obtained by measuring the optical spectrum. Wavelength-resolved signal and noise levels provide information on signal level, signal wavelength, and amplified spontaneous emission (ASE) for each channel. Spectral information, however, does not show signal degradation due to wave-shape impairments resulting from polarization-mode dispersion (PMD), and chromatic dispersion. Also, intersymbol interference and time jitter are not revealed from an optical signal to noise ratio (OSNR) measurement. In spite of these limitations, OSNR is listed as an interface parameter in ITU-T Rec. G.692 [1][1], as an optical monitoring parameter in ITU-T Rec. G.697 [2] and in ITU-T G Rec. Sup. 39 [3].

1 Figures in brackets refer to the bibliography.

FIBRE OPTIC COMMUNICATION SUBSYSTEM TEST PROCEDURES –

Part 2-9: Digital systems – Optical signal-to-noise ratio measurement for dense wavelength-division multiplexed systems

1 Scope

This part of IEC 61280 provides a parameter definition and a test method for obtaining optical signal-to-noise ratio (OSNR) using apparatus that measures the optical spectrum at a multichannel interface. Because noise measurement is made on an optical spectrum analyzer, the measured noise does not include source relative intensity noise (RIN) or receiver noise.

Three implementations for an optical spectrum analyser (OSA) are discussed: a diffraction-grating-based OSA, a Michelson interferometer-based OSA, and a Fabry-Perot-based OSA. Performance characteristics of the OSA that affect OSNR measurement accuracy are provided.

A typical optical spectrum at a multichannel interface is shown in Figure 1. Important characteristics are as follows.

- The channels are placed nominally on the grid defined by ITU Recommendation G.694.1.[4]
- Individual channels may be non-existent because it is a network designed with optical add/drop demultiplexers or because particular channels are out of service.
- Both channel power and noise power are a function of wavelength.

For calculating the OSNR, the most appropriate noise power value is that at the channel wavelength. However, with a direct spectral measurement, the noise power at the channel wavelength is included in the signal power and is difficult to extract. An estimate of the channel noise power can be made by interpolating the noise power value between channels.

The accuracy of estimating the noise power at the signal wavelength by interpolating the noise power at an offset wavelength can be significantly reduced when the signal spectrum extends into the gap between the signals and when components such as add-drop multiplexers along the transmission span modify the spectral shape of the noise. These effects are discussed in further detail in Annex B, and can make the method of this document unusable for some situations. In such cases, where signal and noise cannot be sufficiently separated spectrally, it is necessary to use more complex separation methods, like polarization or time-domain extinction, or to determine signal quality with a different parameter, such as RIN. This is beyond the scope of the current document.

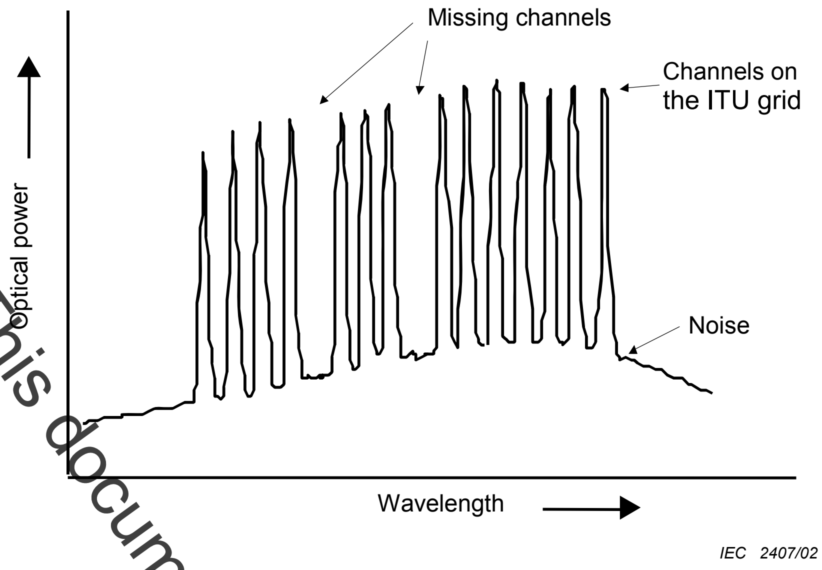

Figure 1 – Typical optical spectrum at an optical interface in a multichannel transmission system

2 Normative references

The following referenced documents are indispensable for the application 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 61290-3-1, *Optical amplifiers – Test methods – Part 3-1: Noise figure parameters – Optical spectrum analyzer method*

IEC 62129, *Calibration of optical spectrum analyzers*

3 Terms and definitions

For the purposes of this document, the following terms and definition apply.

3.1
optical signal-to-noise ratio
OSNR
ratio in decibels, from the optical spectrum, defined by the equation

$$\mathrm{OSNR} = 10\mathrm{Log}\frac{P_i}{N_\mathrm{i}} + 10\mathrm{Log}\frac{B_\mathrm{m}}{B_\mathrm{r}} \quad \mathrm{dB}, \qquad (1)$$

where

P_i is the optical signal power, in watts, at the i-th channel,

B_r is the reference optical bandwidth, and