EESTI STANDARD EVS-EN 61280-2-12:2014

Fibre optic communication subsystem test procedures - Part 2-12: Digital systems - Measuring eye diagrams and Q-factor using a software triggering technique for transmission signal quality assessment

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EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
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Procédures d'essai des sous-systèmes de télécommunication à fibres optiques - Partie 2-12: Systèmes numériques - Mesure des diagrammes de l'oeil et du facteur de qualité à l'aide d'une technique par déclenchement logiciel pour l'évaluation de la qualité de la transmission de signaux (CEI 61280-2-12:2014)

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Foreword

The text of document 86C/1150/CDV, future edition 1 of IEC 61280-2-12, 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 approved by CENELEC as EN 61280-2-12:2014.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2015-03-10
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2017-06-10

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CONTENTS

INTRODUCTION

Signal quality monitoring is important for operation and maintenance of optical transport networks (OTN). From the network operator's point of view, monitoring techniques are required to establish connections, protection, restoration, and/or service level agreements. In order to establish these functions, the monitoring techniques used should satisfy some general requirements:

- in-service (non-intrusive) measurement
- signal deterioration detection (both SNR degradation and waveform distortion)
- fault isolation (localize impaired sections or nodes)
- transparency and scalability (irrespective of the signal bit rate and signal formats)
- simplicity (small size and low cost).

There are several approaches, both analogue and digital techniques, which make it possible to detect various impairments:

- bit error rate (BER) estimation [1,2][1]
- error block detection
- optical power measurement
- optical SNR evaluation with spectrum measurement [3,4]
- pilot tone detection [5,6]
- Q-factor monitoring [7]
- pseudo BER estimation using two decision circuits [8,9]
- histogram evaluation with synchronous eye diagram measurement [10].

A fundamental performance monitoring parameter of any digital transmission system is its end-to-end BER. However, the BER can be correctly evaluated only with out of service BER measurements, using a known test bit pattern in place of the real signal. On the other hand, in-service measurement can only provide rough estimates through the measurement of digital parameters (e.g., BER estimation, error block detection, and error count in forward error correction) or analogue parameters (e.g., optical SNR and Q-factor).

An in-service optical Q-factor monitoring can be used for accurate quality assessment of transmitted signals on wavelength division multiplexed (WDM) networks. Chromatic dispersion (CD) compensation is required for Q monitoring at measurement point in CD uncompensated optical link. However, conventional Q monitoring method is not suitable for signal evaluation of transmission signals, because it requires timing extraction by complex equipment that is specific to each BER and each format.

The software triggering technique [11-14] reconstructs synchronous eye-diagram waveforms without an external clock signal synchronized to optical transmission signal from digital data obtained through asynchronous sampling. It does not rely on an optical signal's transmission rate and data formats (RZ or NRZ). Measuring method of eye diagrams and Q-factor using the software triggering technique is a cost-effective alternative to BER estimations. With eye diagrams and Q-factor using software triggering test method, signal quality degradations due to optical signal-to-noise ratio (OSNR) degradation, to jitter fluctuations and to waveform distortion can be monitored.

This is one of the promising performance-monitoring approaches for intensity modulated direct detection (IM-DD) optical transmission systems.

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1 Numbers in square brackets refer to the Bibliography.

FIBRE OPTIC COMMUNICATION SUBSYSTEM TEST PROCEDURES –

Part 2-12: Digital systems – Measuring eye diagrams and Q-factor using a software triggering technique for transmission signal quality assessment

1 Scope

This part of IEC 61280 defines the procedure for measuring eye diagrams and Q-factor of optical transmission (RZ and NRZ) signals using software triggering technique as shown in 4.1 [14].

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61280-2-2, *Fibre optic communication subsystem basic test procedures – Part 2-2: Test procedure for digital systems – Optical eye pattern, waveform, and extinction ratio measurement*

ITU-T Recommendation G.959.1: 2012, *Optical transport network physical layer interfaces*

3 Abbreviated terms

ASE	amplified spontaneous emission
BER	bit error rate
CD	chromatic dispersion
EDFA	Er-doped fibre amplifier
IM-DD	intensity modulated direct detection
RZ	return-to-zero
NRZ	non-return-to-zero
OBPF	optical bandpass filter
OSNR	optical signal-to-noise ratio
OTN	optical transport networks
PMD	polarization mode dispersion
SNR	signal-to-noise ratio
WDM	wavelength division multiplexing

4 Software synchronization method and Q-factor

4.1 Example of asynchronous waveform and eye diagram reconstructed by software triggering technique

Figure 1 shows an example of a 40 Gb/s RZ-synchronous eye diagram constructed from asynchronous sampled data using the software triggering technique. The inset in Figure 1 shows an asynchronous waveform obtained from the same asynchronous sampled data.