

STN	Skúšobné postupy pre optické vláknové komunikačné podsystemy. Časť 2-12: Digitálne systémy. Meranie očkových diagramov a faktora Q s použitím techniky spúšťania softvérom na posudzovanie kvality prenášaného signálu.	STN EN 61280-2-12 35 9270
------------	--	---

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 11/14

Obsahuje: EN 61280-2-12:2014, IEC 61280-2-12:2014

119725

Úrad pre normalizáciu, metrológiu a skúšobníctvo SR, odbor SÚTN, 2014
Podľa zákona č. 264/1999 Z. z. v znení neskorších predpisov sa môžu slovenské technické normy rozmnožovať a rozširovať iba so súhlasom Úradu pre normalizáciu, metrológiu a skúšobníctvo SR.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 61280-2-12

July 2014

ICS 33.180.10

English Version

**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
(IEC 61280-2-12:2014)**

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)

Prüfverfahren für Lichtwellenleiter-Kommunikationssysteme - Teil 2-12: Digitale Systeme - Messungen von Augendiagrammen und des Q-Faktors mit einem Software-Triggerverfahren für die Qualitätsbewertung von Übertragungssignalen
(IEC 61280-2-12:2014)

This European Standard was approved by CENELEC on 2014-06-10. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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document have to be withdrawn

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61280-2-12:2014 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 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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61280-2-2	-	Fibre optic communication subsystem test procedures - Part 2-2: Digital systems - Optical eye pattern, waveform and extinction ratio measurement	EN 61280-2-2	-
ITU-T Recommendation G.959.1	2012	Optical transport network physical layer interfaces	-	-



INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**

**Procédures d'essai des sous-systèmes de télécommunication à fibres
optiques –
Partie 2-12: Systèmes numériques – Mesure des diagrammes de l'œil 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**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 14 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 55 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



IEC 61280-2-12

Edition 1.0 2014-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**

**Procédures d'essai des sous-systèmes de télécommunication à fibres
optiques –
Partie 2-12: Systèmes numériques – Mesure des diagrammes de l'œil 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**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

R

ICS 33.180.10

ISBN 978-2-8322-1545-6

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Abbreviated terms	6
4 Software synchronization method and Q -factor	6
4.1 Example of asynchronous waveform and eye diagram reconstructed by software triggering technique	6
4.2 Q -factor formula.....	7
5 Apparatus.....	9
5.1 General.....	9
5.2 Optical bandpass filter	10
5.3 High frequency receiver	10
5.4 Clock oscillator	11
5.5 Electric pulse generator	11
5.6 Sampling module	11
5.7 Electric signal processing circuit	12
5.8 Optical clock pulse generator	12
5.9 Optical sampling module	12
5.10 Optical signal processing circuit.....	12
5.11 Synchronization bandwidth	12
5.12 Monitoring system parameters	13
6 Procedure.....	13
6.1 General.....	13
6.2 Measuring eye diagrams and Q calculations	13
Annex A (informative) Example of the signal processing required to reconstruct the synchronous eye diagram	15
Annex B (informative) Adequate sampling time width (gate width).....	17
Bibliography.....	18
Figure 1 – Asynchronous waveform and synchronous eye diagram of 40 Gbps RZ-signal reconstructed by software triggering technique	7
Figure 2 – RZ synchronous eye diagram reconstructed by software triggering technique, time window, and histogram.....	8
Figure 3 – Example of relationship between Q -factor and window width	8
Figure 4 – Test system 1 for measuring eye diagrams and Q -factor using the software triggering technique	9
Figure 5 – Test system 2 for measuring eye diagrams and Q -factor using the software triggering technique	10
Figure A.1 – Block diagram of the software triggering module	15
Figure A.2 – Example of interpolating a discrete spectrum and determining beat frequency.....	16
Figure B.1 – The typical calculated relationship between the adequate sampling time width (gate width) and the bit rate of the optical signal.....	17
Table 1 – Monitoring system parameters.....	13

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning software synchronization given in Clause 4 and procedure for calculating eye-diagrams and Q-factor given in Clause 6.

IEC takes no position concerning the evidence, validity and scope of these patent rights.

The holders of these patent rights have assured the IEC that they are willing to negotiate licences either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of these holders of these patent rights are registered with IEC.

For US patent 6,744,496, information may be obtained from:

Alcatel-Lucent
Intellectual Property Business Group
16 Brookside Dr.
Sutton, MA 01590 USA

For Japanese patent 3987001 and US patent 7190752, information may be obtained from:

Nippon Telegraph and Telephone Corporation
9-11, Midori-cho, 3-Chrome Musashino-Shi
Tokyo 180-8585 Japan

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO (www.iso.org/patents) and IEC (<http://patents.iec.ch>) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

International Standard IEC 61280-2-12 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

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

CDV	Report on voting
86C/1150/CDV	86C/1220/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.

A list of all parts in the IEC 61280 series, published under the general title *Fibre optic communication subsystem test procedures*, 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication 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

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.

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*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN