

Cable networks for television signals, sound signals and interactive services - Part 6: Optical equipment

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 60728-6:2004 sisaldab Euroopa standardi EN 60728-6:2003 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 22.06.2004 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 20.10.2003.

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN 60728-6:2004 consists of the English text of the European standard EN 60728-6:2003.

This standard is ratified with the order of Estonian Centre for Standardisation dated 22.06.2004 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text 20.10.2003.

The standard is available from Estonian standardisation organisation.

ICS 33.060.40, 33.160.99

Võtmesõnad:

Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
Aru 10 Tallinn 10317 Eesti; www.evs.ee; Telefon: 605 5050; E-post: info@evs.ee

English version

**Cable networks for television signals,
sound signals and interactive services
Part 6: Optical equipment
(IEC 60728-6:2003)**

Réseaux de distribution par câbles
pour signaux de télévision,
signaux de radiodiffusion sonore
et services interactifs
Partie 6: Matériels optiques
(CEI 60728-6:2003)

Kabelnetze für Fernsehsignale,
Tonsignale und interaktive Dienste
Teil 6: Optische Geräte
(IEC 60728-6:2003)

This European Standard was approved by CENELEC on 2003-10-01. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 100/680/FDIS, future edition 2 of IEC 60728-6, prepared by IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60728-6 on 2003-10-01.

This European Standard supersedes EN 50083-6:1997.

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) 2004-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-10-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annexes A and B are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60728-6:2003 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60793-2-50	NOTE	Harmonized as EN 60793-2-50:2002 (not modified).
IEC 60825-1	NOTE	Harmonized as EN 60825-1:1994 (not modified).
IEC 61290-1-1	NOTE	Harmonized as EN 61290-1-1:1998 (not modified).
IEC 61290-1-2	NOTE	Harmonized as EN 61290-1-2:1998 (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-1	- ¹⁾	Environmental testing Part 1: General and guidance	EN 60068-1	1994 ²⁾
IEC 60068-2	series	Part 2: Tests	EN 60068-2	series
IEC 60169-2	- ¹⁾	Radio-frequency connectors Part 2: Coaxial unmatched connector	HD 134.2 S2	1984 ²⁾
IEC 60169-24	- ¹⁾	Part 24: Radio-frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (Type F)	EN 60169-24	1993 ²⁾
IEC 60417 database	2002	Graphical symbols for use on equipment	-	-
IEC 60529	- ¹⁾	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 ²⁾ 1993
IEC 60617 database	series	Graphical symbols for diagrams	-	-
IEC 60728-1	- ¹⁾	Cabled distribution systems for television and sound signals Part 1: Methods of measurement and system performance	-	-
IEC 60728-2	- ¹⁾	Part 2: Electromagnetic compatibility for equipment	-	-
IEC 60728-3	- ¹⁾	Part 3: Active coaxial wideband distribution equipment	-	-

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61280-2-2	- ¹⁾	Fibre optic communication subsystem basic test procedures Part 2-2: Test procedures for digital systems - Optical eye pattern, waveform, and extinction ratio	EN 61280-2-2	1999 ²⁾
IEC 61280-4-2	- ¹⁾	Part 4-2: Fibre optic cable plant - Single-mode fibre optic cable plant attenuation	EN 61280-4-2	1999 ²⁾
IEC/TR 61282-4	- ¹⁾	Fibre optic communication system design guides Part 4: Accommodation and utilization of non-linear effects	-	-
IEC 61290-1-3	- ¹⁾	Optical fibre amplifiers - Basic specification Part 1-3: Test methods for gain parameters - Optical power meter	EN 61290-1-3	1998 ²⁾
IEC 61290-3	- ¹⁾	Part 3: Test methods for noise figure parameters	EN 61290-3	2000 ²⁾
IEC 61290-3-2	- ¹⁾	Part 3-2: Test methods for noise figure parameters - Electrical spectrum analyzer method	EN 61290-3-2	2003 ²⁾
IEC 61290-5	series	Part 5: Test methods for reflectance parameters	EN 61290-5	series
IEC 61291-1	- ¹⁾	Optical fibre amplifiers Part 1: Generic specification	EN 61291-1	1998 ²⁾
IEC/TR3 61931	- ¹⁾	Fibre optic - Terminology	-	-
IEC 80416	series	Basic principles for graphical symbols for use on equipment	EN 80416	series
ITU-G.692	- ¹⁾	Optical interfaces for multichannel systems with optical amplifiers	-	-
EN 300019-1-3	-	Environmental Engineering (EE) - Environmental conditions and environmental tests for telecommunications equipment Part 1-3: Classification of environmental conditions - Stationery use at weatherprotected locations	-	-

INTERNATIONAL STANDARD

IEC
60728-6

Second edition
2003-07

**Cable networks for television signals,
sound signals and interactive services –**

**Part 6:
Optical equipment**

This document is a preview generated by EVS



Reference number
IEC 60728-6:2003(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (http://www.iec.ch/searchpub/cur_fut.htm) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

This summary of recently issued publications (http://www.iec.ch/online_news/justpub/jp_entry.htm) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

Email: custserv@iec.ch
Tel: +41 22 919 02 11
Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC
60728-6

Second edition
2003-07

**Cable networks for television signals,
sound signals and interactive services –**

**Part 6:
Optical equipment**

© IEC 2003 — Copyright - all rights reserved

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 the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE

XA

For price, see current catalogue

CONTENTS

FOREWORD	4
INTRODUCTION	6
1 Scope	7
2 Normative references	7
3 Terms, definitions, symbols and abbreviations	8
4 Methods of measurement	17
4.1 General measurement requirements	17
4.2 Optical power	17
4.3 Loss, isolation, directivity and coupling ratio	18
4.4 Return loss	19
4.5 Saturation output power of an optical amplifier	20
4.6 Polarization dependent loss	21
4.7 Centroidal wavelength and spectral width under modulation	22
4.8 Linewidth and chirping of transmitters with single mode lasers	23
4.9 Optical modulation index	25
4.10 Reference output level of an optical receiver	26
4.11 Slope and flatness	27
4.12 Composite second order distortion (CSO) of optical transmitters	29
4.13 Composite triple beats (CTB) of optical transmitters	30
4.14 Composite crossmodulation of optical transmitters	31
4.15 Receiver intermodulation	33
4.16 CSO of optical amplifiers	36
4.17 CTB of optical amplifiers	36
4.18 Carrier-to-noise ratio	36
4.19 Method for combined measurement of relative intensity noise (RIN), optical modulation index and equivalent input noise current	40
4.20 Noise figure of optical amplifiers	42
4.21 Influence of fibre	43
4.22 SBS threshold	43
5 Universal performance requirements and recommendations	44
5.1 Safety	44
5.2 Electromagnetic compatibility (EMC)	44
5.3 Environmental	44
5.4 Marking	45
6 Active equipment	45
6.1 Optical downlink transmitters	45
6.2 Optical uplink transmitters	47
6.3 Optical receivers	49
6.4 Optical amplifiers	51
7 Passive equipment	52
7.1 Connectors and splices	52
7.1.1 Data publication requirements	52
Annex A (informative) A simplified method of measurement for return loss	53
Annex B (informative) Product specification worksheets for optical amplifiers	55
Bibliography	58

Figure 1 – Measurement of optical power.....	18
Figure 2 – Measurement of optical loss, directivity and isolation.....	19
Figure 3 – Measurement of the optical return loss.....	20
Figure 4 – Optical saturation output power.....	21
Figure 5 – Measurement of the polarization dependent loss.....	21
Figure 6 – Measurement of central wavelength and spectral width under modulation.....	22
Figure 7 – Measurement of the chirping and the linewidth of transmitters.....	24
Figure 8 – Measurement of the optical modulation index.....	26
Figure 9 – Measurement of the reference output level of an optical receiver.....	27
Figure 10 – Measurement of the frequency range and flatness.....	28
Figure 11 – Evaluation of the slope.....	28
Figure 12 – Evaluating the flatness.....	29
Figure 13 – Device under test for measuring CSO of optical transmitters.....	30
Figure 14 – Device under test for measuring CTB of optical transmitters.....	31
Figure 15 – Arrangement for measuring composite crossmodulation of optical transmitters.....	32
Figure 16 – Arrangement of test equipment for measuring receiver intermodulation.....	35
Figure 17 – System with internal noise sources.....	36
Figure 18 – PIN diode receiver.....	37
Figure 19 – Optical transmission system under test.....	38
Figure 20 – Arrangement of test equipment for carrier-to-noise measurement.....	38
Figure 21 – Measurement set-up for determination of the noise parameters and the optical modulation index.....	42
Figure 22 – Arrangement for measuring the SBS threshold.....	44
Figure 23 – Classification of uplink transmitters.....	48
Figure A.1 – Test set-up for calibration.....	53
Figure A.2 – Measurement of the optical power of the light source.....	54
Figure A.3 – Test set-up for device under test.....	54
Figure A.4 – Measurement of the optical power at port A.....	54
Table 1 – Noise correction factors C_n for different noise level differences D	40
Table 2 – Data publication requirements for optical downlink transmitters.....	46
Table 3 – Recommendations for optical downlink transmitters.....	46
Table 4 – Requirements for optical downlink transmitters.....	47
Table 5 – Data publication requirements for optical uplink transmitters.....	48
Table 6 – Recommendations for optical uplink transmitters.....	49
Table 7 – Requirements for optical uplink transmitters.....	49
Table 8 – Classification of optical receivers.....	50
Table 9 – Data publication requirements for optical receivers.....	50
Table 10 – Recommendations for optical receivers.....	50
Table 11 – Performance requirements for optical receivers.....	51
Table B.1 – Minimum list of relevant parameters of power amplifiers to be specified for analogue applications.....	55
Table B.2 – Minimum list of relevant parameters of line amplifiers to be specified for analogue applications.....	56
Table B.3 – Minimum list of relevant parameters of optically amplified transmitters (OAT) to be specified for analogue applications.....	57

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CABLE NETWORKS FOR TELEVISION SIGNALS,
SOUND SIGNALS AND INTERACTIVE SERVICES –****Part 6: Optical equipment**

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, 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

International Standard IEC 60728-6 has been prepared by technical area 5: Cable networks for television signals, sound signals and interactive services, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 2001 of which it constitutes a technical revision.

The text of this standard is based on

FDIS	Report on voting
100/680/FDIS	100/697/RVD

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.

The committee has decided that this publication remains valid until 2006. At this date, in accordance with the committee's decision, the publication will be:

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

This document is a preview generated by EVS

INTRODUCTION

Standards of the IEC 60728 series deal with cable networks for television signals, sound signals and interactive services including equipment, systems and installations:

- for headend-reception, processing and distribution of sound and television signals and their associated data signals, and
- for processing, interfacing and transmitting all kinds of interactive multimedia signals using all applicable transmission media.

They cover all kinds of networks that convey modulated RF carriers such as

- CATV-networks;
- MATV-networks and SMATV-networks;
- individual receiving networks;

and all kinds of equipment, systems and installations installed in such networks.

The scope of these standards extends from antennas and special signal source inputs to headend or other interface points, to networks as a whole up through system outlets, or terminal inputs where no system outlet exists.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals, etc.) is excluded.

This document is a preview generated by EVS

CABLE NETWORKS FOR TELEVISION SIGNALS, SOUND SIGNALS AND INTERACTIVE SERVICES –

Part 6: Optical equipment

1 Scope

This part of IEC 60728 lays down the measuring methods, performance requirements and data publication requirements of optical equipment of cable networks for television signals, sound signals and interactive services.

This standard

- applies to all optical transmitters, receivers, amplifiers, directional couplers, isolators, multiplexing devices, connectors and splices used in cable networks;
- covers the frequency range 5 MHz to 3 000 MHz;
NOTE The upper limit of 3 000 MHz is an example, but not a strict value. The frequency range or ranges, over which the equipment is specified, shall be published.
- identifies guaranteed performance requirements for certain parameters;
- lays down data publication requirements with guaranteed performance;
- describes methods of measurement for compliance testing.

All requirements and published data relate to minimum performance levels within the specified frequency range and in well-matched conditions as might be applicable to cable networks for television signals, sound signals and interactive services.

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 60068-1, *Environmental testing. Part 1: General and guidance*

IEC 60068-2, (all parts), *Environmental testing – Part 2: Tests*

IEC 60169-2, *Radio-frequency connectors – Part 2: Coaxial unmatched connector*

IEC 60169-24, *Radio-frequency connectors – Part 24: Radio-frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (Type F)*

IEC 60417-DB:2002*, *Graphical symbols for use on equipment*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60617 (all parts) [DB]*, *Graphical symbols for diagrams*

* "DB" refers to the IEC on-line database.

IEC 60728-1, *Cabled distribution systems for television and sound signals – Part 1: Methods of measurement and system performance*

IEC 60728-2, *Cabled distribution systems for television and sound signals – Part 2: Electromagnetic compatibility of equipment*

IEC 60728-3, *Cabled distribution systems for television and sound signals – Part 3: Active coaxial wideband distribution equipment*

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

IEC 61280-4-2, *Fibre optic communication subsystem basic test procedures – Part 4-2: Fibre optic cable plant – Single-mode fibre optic cable plant attenuation*

IEC 61282-4, *Fibre optic communication system design guides – Part 4: Guideline to accommodate and utilize nonlinear effects in single-mode fibre optic systems*

IEC 61290-1-3, *Optical fibre amplifiers – Basic specification – Part 1-3: Test methods for gain parameters – Optical power meter*

IEC 61290-3, *Optical fibre amplifiers – Basic specification – Part 3-1: Test methods for noise figure parameters*

IEC 61290-3-2, *Optical fibre amplifiers – Part 3-2: Test methods for noise figure parameters – Electrical spectrum analyzer*

IEC 61290-5, *Optical fibre amplifiers – Basic specification – Part 5: Test methods for reflectance parameters*

IEC 61291-1, *Optical fibre amplifiers – Part 1: Generic specification*

IEC 61931, *Fibre optics – Terminology*

IEC 80416, *Basic principles for graphical symbols for use on equipment*

ITU G.692, *Optical interfaces for multichannel systems with optical amplifiers*

EN 300019-1-3, *Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the definitions given in IEC 60728-1, IEC 61931 and the following terms and definitions apply.

3.1.1

optical transmitting unit; optical transmitter; Tx (abbreviation)

transmit fibre optic terminal device accepting at its input port an electrical signal and providing at its output port an optical carrier modulated by that input signal

NOTE For the purposes of this standard, optical transmitters may have more than one input port accepting electrical RF signals.

[IEC 61931, definition 2.9.6]