



NSAI
Standards

Irish Standard
I.S. EN IEC 60728-3:2018

Cable networks for television signals, sound signals and interactive services - Part 3:
Active wideband equipment for cable networks (TA 5)

I.S. EN IEC 60728-3:2018

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

EN IEC 60728-3:2018

Published:

2018-02-23

This document was published under the authority of the NSAI and comes into effect on:

2018-03-13

ICS number:

33.060.40

33.170

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

National Foreword

I.S. EN IEC 60728-3:2018 is the adopted Irish version of the European Document EN IEC 60728-3:2018, Cable networks for television signals, sound signals and interactive services - Part 3: Active wideband equipment for cable networks (TA 5)

This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

For relationships with other publications refer to the NSAI web store.

Compliance with this document does not of itself confer immunity from legal obligations.

In line with international standards practice the decimal point is shown as a comma (,) throughout this document.

This page is intentionally left blank

EUROPEAN STANDARD

EN IEC 60728-3

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2018

ICS 33.060.40; 33.170

Supersedes EN 60728-3:2011

English Version

**Cable networks for television signals, sound signals and
interactive services - Part 3: Active wideband equipment for
cable networks (TA 5)
(IEC 60728-3:2017)**

Réseaux de distribution par câbles pour signaux de
télévision, signaux de radiodiffusion sonore et services
interactifs - Partie 3: Matériel actif à large bande pour
réseaux de distribution par câbles
(IEC 60728-3:2017)

Kabelnetze für Fernsehsignale, Tonsignale und interaktive
Dienste - Teil 3: Aktive Breitbandgeräte für Kabelnetze
(IEC 60728-3:2017)

This European Standard was approved by CENELEC on 2018-01-01. 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 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, Serbia, 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: Rue de la Science 23, B-1040 Brussels

EN IEC 60728-3:2018 (E)

European foreword

The text of document 100/2975/FDIS, future edition 5 of IEC 60728-3, prepared by technical area 5 "Cable networks for television signals, sound signals and interactive services" of IEC/TC 100 "Audio, video and multimedia systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60728-3:2018.

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) 2018-10-01
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2021-01-01

This document supersedes EN 60728-3:2011, EN 60728-3-1:2012 and CLC/TS 50083-3-3:2014.

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

Endorsement notice

The text of the International Standard IEC 60728-3:2017 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 60728-1	NOTE	Harmonized as EN 60728-1.
IEC 60728-6:2011	NOTE	Harmonized as EN 60728-6:2011 (not modified)
IEC 60728-10	NOTE	Harmonized as EN 60728-10
IEC 61169-2	NOTE	Harmonized as EN 61169-2
IEC 61169-24	NOTE	Harmonized as EN 61169-24
ISO 80416 series	NOTE	Harmonized in EN 80416 series

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where 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 60068-1	-	Environmental testing -- Part 1: General and guidance	EN 60068-1	-
IEC 60068-2-1	-	Environmental testing -- Part 2-1: Tests - Test A: Cold	EN 60068-2-1	-
IEC 60068-2-2	-	Environmental testing -- Part 2-2: Tests - Test B: Dry heat	EN 60068-2-2	-
IEC 60068-2-6	-	Environmental testing -- Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	-
IEC 60068-2-14	-	Environmental testing -- Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	-
IEC 60068-2-27	-	Environmental testing -- Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	-
IEC 60068-2-30	-	Environmental testing -- Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	-
IEC 60068-2-31	-	Environmental testing -- Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens	EN 60068-2-31	-
IEC 60068-2-40	-	Basic environmental testing procedures - Part 2: Tests. Test Z/AM: Combined cold/low air pressure tests	EN 60068-2-40	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	-	-
IEC 60728-2	-	Cable networks for television signals, sound signals and interactive services - Part 2: Electromagnetic compatibility for equipment	EN 50083-2	-
IEC 60728-4	-	Cable networks for television signals, sound signals and interactive services -- Part 4: Passive wideband equipment for coaxial cable networks	EN 60728-4	-
IEC 60728-5	-	Cable networks for television signals, sound signals and interactive services - Part 5: Headend equipment	EN 60728-5	-
IEC 60728-11	-	Cable networks for television signals, sound signals and interactive services -- Part 11: Safety	EN 60728-11	-
IEC 61000-4-5	-	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	-
IEC 61319-1	-	Interconnections of satellite receiving equipment -- Part 1: Europe	EN 61319-1	-

I.S. EN IEC 60728-3:2018

EN IEC 60728-3:2018 (E)

IEC 61319-2	-	Interconnections of satellite receiving equipment -- Part 2: Japan	-	-
IEC 62368-1	-	Audio/video, information and communication technology equipment -- Part 1: Safety requirements	EN 62368-1	-



IEC 60728-3

Edition 5.0 2017-11

INTERNATIONAL STANDARD

**Cable networks for television signals, sound signals and interactive services
Part 3: Active wideband equipment for cable networks**





THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2017 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.

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 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 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.



IEC 60728-3

Edition 5.0 2017-11

INTERNATIONAL STANDARD

**Cable networks for television signals, sound signals and interactive services
Part 3: Active wideband equipment for cable networks**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.060.40; 33.170

ISBN 978-2-8322-4934-5

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms, definitions, symbols and abbreviated terms.....	9
3.1 Terms and definitions.....	9
3.2 Symbols.....	12
3.3 Abbreviated terms.....	14
4 Methods of measurement	14
4.1 General.....	14
4.2 Linear distortion	15
4.2.1 Return loss	15
4.2.2 Group delay variation	15
4.3 Non-linear distortion.....	16
4.3.1 General	16
4.3.2 Types of measurements.....	16
4.3.3 Intermodulation.....	17
4.3.4 Composite triple beat.....	19
4.3.5 Composite second order beat	22
4.3.6 Method of measurement of non-linearity for pure digital channel load	22
4.3.7 Hum modulation of carrier.....	30
4.4 Noise figure	33
4.4.1 General	33
4.4.2 Equipment required	33
4.4.3 Connection of equipment	33
4.4.4 Measurement procedure	34
4.5 Crosstalk attenuation	34
4.5.1 Crosstalk attenuation for loop-through ports	34
4.5.2 Crosstalk attenuation for output ports	34
4.6 Measurement of noise power ratio (NPR).....	36
4.6.1 General	36
4.6.2 Equipment required	37
4.6.3 Connection of equipment	37
4.6.4 Measurement procedure	38
4.6.5 Presentation of the results	38
4.7 Immunity to surge voltages	39
4.7.1 General	39
4.7.2 Equipment required	39
4.7.3 Connection of equipment	39
4.7.4 Measurement procedure	40
5 Equipment requirements.....	40
5.1 General requirements	40
5.2 Safety.....	40
5.3 Electromagnetic compatibility (EMC).....	40
5.4 Frequency range.....	40
5.5 Impedance and return loss.....	40

5.6	Gain.....	41
5.6.1	Minimum and maximum gain.....	41
5.6.2	Gain control.....	41
5.6.3	Slope and slope control	41
5.7	Flatness.....	41
5.8	Test points	41
5.9	Noise figure	41
5.10	Non-linear distortion.....	42
5.10.1	General	42
5.10.2	Second-order distortion	42
5.10.3	Third order distortion	42
5.10.4	Composite triple beat.....	42
5.10.5	Composite second order.....	42
5.10.6	Maximum operating level for pure digital channel load	42
5.11	Hum modulation.....	43
5.12	Power supply	43
5.13	Environmental.....	43
5.13.1	General	43
5.13.2	Transportation	43
5.13.3	Installation or maintenance.....	43
5.13.4	Operation	43
5.13.5	Energy efficiency of equipment	44
5.14	Marking.....	44
5.14.1	Marking of equipment	44
5.14.2	Marking of ports.....	44
5.15	Requirements for multi-switches	44
5.15.1	Control signals for multi-switches	44
5.15.2	Amplitude frequency response flatness.....	44
5.15.3	Return loss	44
5.15.4	Through loss.....	44
5.15.5	Isolation.....	44
5.15.6	Crosstalk attenuation	44
5.15.7	Satellite IF to terrestrial signal isolation	45
5.16	Immunity to surge voltages	45
5.16.1	Degrees of testing levels	45
5.16.2	Recommendation of testing level degree	45
Annex A (normative)	Test carriers, levels and intermodulation products.....	46
A.1	Two signal tests for second- and third-order products	46
A.1.1	Intermodulation products with test signals at frequencies f_a and f_b , see Table A.1	46
A.1.2	Signal levels	46
A.2	Three signal tests for third order products – Intermodulation products with test signals at frequencies f_a , f_b and f_c , see Table A.2 and Figure A.3	47
Annex B (informative)	Test frequency plan for composite triple beat (CTB), composite second order (CSO).....	48
Annex C (informative)	Measurement errors that occur due to mismatched equipment	50
Annex D (informative)	Examples of measurement channels	51
D.1	Operating frequency range 110 MHz to 1 006 MHz	51
D.2	Operating frequency range 110 MHz to 862 MHz	51

D.3	Operating frequency range 258 MHz to 1 218 MHz	51
	Bibliography.....	52
Figure 1	– Basic arrangement of test equipment for evaluation of the ratio of signal to intermodulation product	18
Figure 2	– Connection of test equipment for the measurement of non-linear distortion by composite beat.....	21
Figure 3	– BER measurement test configuration	24
Figure 4	– CINR measurement test setup.....	28
Figure 5	– Plot of CINR in dB curve (forward path) versus EUT channel output signal level in dB μ V	29
Figure 6	– Carrier/hum ratio	30
Figure 7	– Test set-up for local-powered objects	31
Figure 8	– Test set-up for remote-powered objects	31
Figure 9	– Oscilloscope display	32
Figure 10	– Measurement of noise figure	33
Figure 11	– Measurement of crosstalk attenuation for loop through ports of multi-switches.....	36
Figure 12	– Characteristic of the noise filter.....	37
Figure 13	– Test setup for the non-linearity measurement.....	37
Figure 14	– Presentation of the result of <i>NPR</i>	39
Figure 15	– Measurement set-up for surge immunity test	40
Figure A.1	– An example showing products formed when $2f_a > f_b$	46
Figure A.2	– An example showing products formed when $2f_a < f_b$	47
Figure A.3	– Products of the form $f_a \pm f_b \pm f_c$	47
Figure C.1	– Error concerning return loss measurement	50
Figure C.2	– Maximum ripple	50
Table 1	– Measurement parameters for full channel load	26
Table 2	– Notch filter frequencies	37
Table 3	– Example of return loss requirements	41
Table 4	– Parameters of surge voltages for different degrees of testing levels	45
Table 5	– Recommendations for degree of testing levels	45
Table A.1	– Intermodulation products with two signals	46
Table A.2	– Intermodulation products with three signals.....	47
Table B.1	– Frequency allocation plan	48

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 3: Active wideband equipment for cable networks

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.

International Standard IEC 60728-3 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 fifth edition cancels and replaces the fourth edition published in 2010. This edition constitutes a technical revision.

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

- a) extension of upper frequency range limit for cable network equipment in the forward path from 1 000 MHz to 1 218 MHz (optional up to 1 794 MHz);
- b) extension of upper frequency range limit for cable network equipment in the return path from 85 MHz to 204 MHz;
- c) integration and update of IEC 60728-3-1 content;

- d) integration and update of the Technical Specification CLC/TS 50083-3-3 content;
- e) deletion of specifications and test methods for obsolete analogue parameters;
- f) additional normative references;
- g) additional terms and definitions and abbreviations.

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

FDIS	Report on voting
100/2975/FDIS	100/2990/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.

The list of all the parts of the IEC 60728 series, under the general title *Cable networks for television signals, sound signals and interactive services*, 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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Standards and other deliverables of the IEC 60728 series deal with cable networks, including equipment and associated methods of measurement for headend reception, processing and distribution of television and sound signals and for processing, interfacing and transmitting all kinds of data signals for interactive services using all applicable transmission media. These signals are typically transmitted in networks by frequency-multiplexing techniques.

This includes for instance:

- regional and local broadband cable networks,
- extended satellite and terrestrial television distribution systems,
- individual satellite and terrestrial television receiving systems,

and all kinds of equipment, systems and installations used in such cable networks, distribution and receiving systems.

The extent of this standardization work is from the antennas and/or special signal source inputs to the headend or other interface points to the network up to the terminal input of the customer premises equipment.

The standardization work will consider coexistence with users of the RF spectrum in wired and wireless transmission systems.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals, etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.

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

Part 3: Active wideband equipment for cable networks

1 Scope

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

This document

- applies to all amplifiers 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.

- applies to one-way and two-way equipment;
- specifies the basic methods of measurement of the operational characteristics of the active equipment in order to assess the performance of this equipment;
- identifies the performance specifications to be published by the manufacturers;
- states the minimum performance requirements of certain parameters.

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

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test dB: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-40, *Basic environmental testing procedures – Part 2-40: Tests – Test Z/AM: Combined cold/low air pressure tests*

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- [Looking for additional Standards? Visit Intertek Inform Infostore](#)
 - [Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation](#)
-