IEC 60728-103

Edition 1.0 2026-11

INTERNATIONAL STANDARD

Cable networks for television signals, sound signals and interactive services - Part 103: Active wideband equipment for cable networks with digital signals only

ICS 33.060.40; 33.170

ISBN 978-2-8327-1590-1

IEC 60728-103:2026-11 (en)

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms, definitions, symbols and abbreviated terms 8
3.1 Terms and definitions 8
3.2 Symbols 12
3.3 Abbreviated terms 13
4 Methods of measurement 13
4.1 General 13
4.2 Linear distortion 14
4.2.1 Return loss 14
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 16
4.3.4 Method of measurement of non-linearity for pure digital channel load for channel loads up to 1 218 MHz 19
4.3.5 Method of measurement of non-linearity for pure digital channel load for channel loads up to 1 794 MHz 24
4.3.6 Hum modulation of carrier 28
4.4 Noise figure 32
4.4.1 General 32
4.4.2 Equipment required 32
4.4.3 Connection of equipment 32
4.4.4 Measurement procedure 32
4.5 Crosstalk attenuation 33
4.5.1 Crosstalk attenuation for loop-through ports 33
4.5.2 Crosstalk attenuation for output ports 33
4.6 Immunity to surge voltages 35
4.6.1 General 35
4.6.2 Equipment required 36
4.6.3 Connection of equipment 36
4.6.4 Measurement procedure 36
5 Performance requirements 36
5.1 General requirements 36
5.2 Safety 36
5.3 Electromagnetic compatibility (EMC) 37
5.4 Frequency range 37
5.5 Impedance and return loss 37
5.6 Gain 37
5.6.1 Minimum and maximum gain 37
5.6.2 Gain control 37
5.6.3 Slope and slope control 37
5.7 Flatness 37
5.8 Test points 38

5.9 Noise figure 38
5.10 Non-linear distortion 38
5.10.1 General 38
5.10.2 Second-order distortion 38
5.10.3 Third order distortion 38
5.10.4 Maximum operating level for pure digital channel load 38
5.11 Hum modulation 39
5.12 Power supply 39
5.13 Environmental information 39
5.13.1 General 39
5.13.2 Transportation 39
5.13.3 Installation or maintenance 39
5.13.4 Operation 40
5.14 Marking of ports 40
5.15 Requirements for multi-switches 40
5.15.1 Control signals for multi-switches 40
5.15.2 Amplitude frequency response flatness 40
5.15.3 Return loss 40
5.15.4 Through loss 40
5.15.5 Isolation 40
5.15.6 Crosstalk attenuation 41
5.15.7 Satellite IF to terrestrial signal isolation 41
5.16 Immunity to surge voltages 41
5.16.1 Degrees of testing levels 41
5.16.2 Recommendation of testing level degree 41
Annex A (normative) Test carriers, levels and intermodulation products 42
A.1 General considerations on intermodulation products 42
A.1.1 General 42
A.1.2 Two signals 42
A.1.3 Three signals 43
A.2 Two signal tests for second- and third-order products 43
A.2.1 Intermodulation products with test signals at frequencies f_a and f_b, see Table A.3 43
A.2.2 Signal levels 44
A.3 Three signal tests for third order products – Intermodulation products with test signals at frequencies f_a, f_b and f_c, see Table A.4 and Figure A.3 45
Annex B (informative) Measurement errors that occur due to mismatched equipment 46
Annex C (informative) Examples of measurement channels 47
C.1 Operating frequency range 110 MHz to 1 006 MHz 47
C.2 Operating frequency range 258 MHz to 1 218 MHz 47
C.3 Operating frequency range 258 MHz to 1 794 MHz 47
Bibliography 48

Figure 1 – Basic arrangement of test equipment for evaluation of the ratio of signal to intermodulation product 17
Figure 2 – BER measurement test configuration 20
Figure 3 – CINR measurement test setup 26

Figure 4 – Plot of CINR in dB curve (forward path) as function of EUT channel output signal level in dB(µV) 28
Figure 5 – Carrier to hum ratio 28
Figure 6 – Test set-up for local-powered objects 29
Figure 7 – Test set-up for remote-powered objects 30
Figure 8 – Spectrum analyser display 30
Figure 9 – Measurement of noise figure 32
Figure 10 – Measurement of crosstalk attenuation for loop-through ports of multi-switches 35
Figure 11 – Measurement set-up for surge immunity test 36
Figure A.1 – An example showing products formed when $2f_a > f_b$ 44
Figure A.2 – An example showing products formed when $2f_a < f_b$ 44
Figure A.3 – Products of the form $f_a \pm f_b \pm f_c$ 45
Figure B.1 – Error concerning return loss measurement 46
Figure B.2 – Maximum ripple 46

Table 1 – Graphical symbols used in figures 12
Table 2 – Measurement parameters for full channel load 22
Table 3 – Common RF output profiles for characterization for the channel bandwidth of 8 MHz 24
Table 4 – Measurement parameters for full channel load 25
Table 5 – Example of return loss requirements 37
Table 6 – Parameters of surge voltages for different degrees of testing levels 41
Table 7 – Recommendations for degree of testing levels 41
Table A.1 – Intermodulation products with two signals 42
Table A.2 – Intermodulation products with three signals 43
Table A.3 – Intermodulation products with two signals 43
Table A.4 – Intermodulation products with three signals 45

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

Cable networks for television signals, sound signals and interactive services - Part 103: Active wideband equipment for cable networks with digital signals only

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60728-103 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

IEC 60728-3:2017, fifth edition, has served as a basis for the development of this document.

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

Draft	Report on voting
100/4567/FDIS	100/4617/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

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

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

INTRODUCTION

International 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 considers coexistence with users of the radio frequency (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.

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 with digital signals only.

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.

While IEC 60728-3:2017 has served as a basis for its development, this document describes the methods of measurement for digital modulated signals only. It also covers the Data Over Cable Service Interface Specification (DOCSIS) 4.0 requirements with additional digital modulation schemes as well as for the extended frequency ranges:

– up to 1 794 MHz for the forward path;
– up to 684 MHz for the return path.

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 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*

IEC 60728-4, *Cable networks for television signals, sound signals and interactive services - Part 4: Passive wideband equipment for coaxial cable networks*

IEC 60728-11, *Cable networks for television signals, sound signals and interactive services - Part 11: Safety*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test*

IEC 61319-1, *Interconnections of satellite receiving equipment - Part 1: Europe*

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*

Bibliography

IEC 60417, *Graphical symbols for use on equipment*, available at https://products.iec.ch

IEC 60617, *Graphical symbols for diagrams*, available at https://products.iec.ch

IEC 60728-1, *Cable networks for television signals, sound signals and interactive services - Part 1: System performance of forward paths*

IEC 60728-9, *Cabled distribution systems for television and sound signals - Part 9: Interfaces of cabled distribution systems for digitally modulated signals*

IEC 60728-10, *Cable networks for television signals, sound signals and interactive services - Part 10: System performance of return paths*

ISO 80416 (all parts), *Basic principles for graphical symbols for use on equipment*

ETSI EN 302 878 (all parts): *Access, Terminals, Transmission and Multiplexing (ATTM); Third Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems*

ETSI EN 300 429 (DVB-C), *Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems*

ANSI SCTE 279, *1.8 GHz Broadband Radio Frequency Hardline Amplifiers for Cable Systems*

_____