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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Email: csc@iec.ch
Tél.: +41 22 919 02 11
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 3: Active wideband equipment for cable networks

FOREWORD

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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 fourth edition cancels and replaces the third edition published in 2005 of which it constitutes a technical revision.

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

- extension of upper frequency range limit for cable network equipment from 862 MHz to 1 000 MHz;
- method of measurement and requirements for immunity to surge voltages;
- extension of scope to equipment using symmetrical ports;
- additional normative references;

- additional terms and definitions and abbreviations.

This bilingual version, published in 2011-07, corresponds to the English version.

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

FDIS	Report on voting
100/1746/FDIS	100/1766/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.

The French version of this standard has not been voted upon.

This publication 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 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

Standards of the IEC 60728 series deal with cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television signals, sound signals and their associated data signals and for processing, interfacing and transmitting all kinds of signals for interactive services using all applicable transmission media.

This includes

- CATV[1]-networks;
- MATV-networks and SMATV-networks;
- individual receiving networks;

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

For active equipment with balanced RF signal ports this standard applies to those ports which carry RF broadband signals for services as described in the scope of this standard.

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.

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] This word encompasses the HFC (Hybrid Fibre Cable) networks used nowadays to provide telecommunications services, voice, data, audio and video both broadcast and narrowcast.

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 lays down 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 standard

- applies to all broadband 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. The frequency range, or ranges, over which the equipment is specified, should be published.

- applies to one-way and two-way equipment;
- lays down 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.

Amplifiers are divided into the following two quality levels:

Grade 1: amplifiers typically intended to be cascaded;

Grade 2: amplifiers for use typically within an apartment block, or within a single residence, to feed a few outlets.

Practical experience has shown that these types meet most of the technical requirements necessary for supplying a minimum signal quality to the subscribers. This classification is not a requirement but is provided to users and manufacturers for information about minimum quality criteria of the material required to install networks of different sizes. The system operator has to select appropriate material to meet the minimum signal quality at the subscriber's outlet, and to optimise cost/performance, taking into account the size of the network and local circumstances.

All requirements and published data are understood as guaranteed values within the specified frequency range and in well-matched conditions.

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 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60068-1:1998, *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 60068-2-29, *Basic environmental testing procedures – Part 2-29: Tests – Test Eb and guidance: Bump*

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 60068-2-32, *Basic environmental testing procedures – Part 2-32: Tests – Test Ed: Free fall*

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

IEC 60068-2-48, *Basic environmental testing procedures – Part 2-48: Tests – Guidance on the application of the tests of IEC publication 60068 to simulate the effects of storage*

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

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

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 60728-5, *Cable networks for television signals, sound signals and interactive services – Part 5: Headend equipment*

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

IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*

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*

ITU-T Recommendation G.117, *Transmission systems and media – Digital systems and networks – International telephone connections and circuits – General recommendations on the transmission quality for an entire international telephone connection – Transmission aspects of unbalance about earth*

ITU-T Recommendation O.9, *Specifications of measuring equipment – General – Measuring arrangements to assess the degree of unbalance about earth*

3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the following terms, definitions, symbols and abbreviations apply.

3.1 Terms and definitions

3.1.1
amplitude frequency response
gain or loss of an equipment or system plotted against frequency

3.1.2
attenuation
ratio of the input power to the output power of an equipment or system, usually expressed in decibels

3.1.3
balun
device to match symmetrical impedance 100 Ω (balanced) to un-symmetrical impedance 75 Ω (unbalanced) and vice-versa

3.1.4
carrier-to-noise ratio
difference in decibels between the vision or sound carrier level at a given point in an equipment or system and the noise level at that point (measured within a bandwidth appropriate to the television or radio system in use)

3.1.5
chrominance-luminance delay inequality
difference in transmission delay of chrominance and luminance signals, which results in the spilling of colour to left or right of the area of corresponding luminance

[IEC 60050-723:1997, 723-06-61]

3.1.6
composite intermodulation noise
CIN
sum of noise and intermodulation products from digital modulated signals

3.1.7
composite intermodulation noise ratio
CINR
ratio of the signal level and the CIN level

3.1.8
crossmodulation
undesired modulation of the carrier of a desired signal by the modulation of another signal as a result of equipment or system non-linearities

3.1.9
crosstalk attenuation
unwanted signals beside the wanted signal on a lead caused by electromagnetic coupling between leads; ratio of the wanted signal power to the unwanted signal power, while equal signal powers are applied to the leads

NOTE Crosstalk attenuation is usually expressed in decibels.

3.1.10
decibel ratio
ten times the logarithm of the ratio of two quantities of power P_1 and P_2, i.e.

$$10\lg\frac{P_1}{P_2} \quad \text{in dB}$$

3.1.11
equaliser
device designed to compensate over a certain frequency range for the amplitude/frequency distortion or phase/frequency distortion introduced by feeders or equipment

NOTE This device is for the compensation of linear distortions only.

3.1.12
feeder
transmission path forming part of a cable network

NOTE Such a path may consist of a metallic cable, optical fibre, waveguide or any combination of them. By extension, the term is also applied to paths containing one or more radio links.

3.1.13
gain
ratio of the output power to the input power, usually expressed in decibels

3.1.14
ideal thermal noise
noise generated in a resistive component due to the thermal agitation of electrons

NOTE The thermal power generated is given by

$$P = 4 \cdot B \cdot k \cdot T$$

where

P is the noise power in watts;

B is the bandwidth in hertz;

k is the Boltzmann's constant = $1{,}38 \cdot 10^{-23}$ J/K;

T is the absolute temperature in kelvins.

It follows that

$$\frac{U^2}{R} = 4 \cdot B \cdot k \cdot T$$

and

$$U = \sqrt{4 \cdot R \cdot B \cdot k \cdot T}$$

where

U is the noise voltage (e.m.f.);

R is the resistance in ohms.

In practice, it is normal for the source to be terminated with a load equal to the internal resistance value, the noise voltage at the input is then $U/2$.

3.1.15
level
decibel ratio of any power P_1 to the standard reference power P_0, i.e.

$$10 \lg \frac{P_1}{P_0}$$

decibel ratio of any voltage U_1 to the standard reference voltage U_0, i.e.

$$20 \lg \frac{U_1}{U_0}$$

NOTE The power level may be expressed in decibels relative to $P_0 = (U_0^2/R) = (1/75)$ pW, i.e. in dB(P_0), taking into account that the level of P_0 corresponds to 0 dB(P_0) or, as more usually, in dB(pW), taking into account that the level of P_0 corresponds to –18,75 dB(pW). The voltage level is expressed in decibels relative to 1 μV (across 75 Ω), i.e. in dB(μV).

3.1.16
modulation error ratio
MER
sum of the squares of the magnitudes of the ideal symbol vectors is divided by the sum of the squares of the magnitudes of the symbol error vectors of a sequence of symbols, the result being expressed as a power ratio in dB

$$MER = 10 \lg \left\{ \frac{\sum_{j=1}^{N} \left(I_j^2 + Q_j^2 \right)}{\sum_{j=1}^{N} \left(\delta I_j^2 + \delta Q_j^2 \right)} \right\} \text{ in dB}$$

3.1.17
multi-switch
equipment used in distribution systems for signals that are received from satellites and converted to a suitable IF

NOTE The IF signals that are received from different polarisations, frequency bands and orbital positions are input signals to the multi-switch. Subscriber feeders are connected to the multi-switch output ports. Each output port is switched to one of the input ports, depending on control signals that are transmitted from the subscriber equipment to the multi-switch. Besides a splitter for each input port and a switch for each output port, a multi-switch can contain amplifiers to compensate for distribution or cable losses.

3.1.18
multi-switch loop through port
one or more ports to loop through the input signals through a multi-switch

NOTE This enables larger networks with multiple multi-switches, each one installed close to a group of subscribers. The multi-switches are connected in a loop through manner. The IF signals that are received by an outdoor unit from different polarisations, frequency bands and orbital positions are input signals to a first multi-switch. Cables connect the loop through ports of this multi-switch to the input ports of a second multi-switch and so on.

3.1.19
multi-switch port for terrestrial signals
port in a multi-switch used to distribute terrestrial signals in addition to the signals received from satellites

3.1.20
noise factor/noise figure
used as figures of merit describing the internally generated noise of an active device

NOTE The noise factor, F, is the ratio of the carrier-to-noise ratio at the input, to the carrier-to-noise ratio at the output of an active device.