

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**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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**CABLE NETWORKS FOR TELEVISION SIGNALS,
SOUND SIGNALS AND INTERACTIVE SERVICES –****Part 3: Active wideband equipment for cable networks**

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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 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
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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.

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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

[IEC 60728-3:2017](https://standards.iteh.ai/catalog/standards/sist/550778cf-9bbb-4c65-85d9-7d932b76b820/iec-60728-3-2017)

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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*

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 60728-5, *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 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*

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3 Terms, definitions, symbols and abbreviated terms

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

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- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

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

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)

3.1.4

composite intermodulation noise

CIN

sum of noise and intermodulation products from digital modulated signals

3.1.5**CINR****composite intermodulation noise ratio**

ratio of the signal level and the CIN level

3.1.6**crosstalk attenuation**

ratio of the wanted signal power to the unwanted signal power, which is caused by electromagnetic coupling between two leads, while equal signal powers are applied to the leads

Note 1 to entry: Crosstalk attenuation is usually expressed in decibels.

3.1.7**decibel ratio**

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

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

3.1.8**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 1 to entry: This device is for the compensation of linear distortions only.

3.1.9**feeder**

transmission path forming part of a cable network

Note 1 to entry: 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.

3.1.10**gain**

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

3.1.11**ideal thermal noise**

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

Note 1 to entry: 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 = $1,38 \times 10^{-23}$ 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 $U/2$.

3.1.12

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.

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

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Note 1 to entry: 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 μ V (across 75 Ω), i.e. in dB(μ V).

3.1.13

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

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

3.1.14

multi-switch

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

Note 1 to entry: 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.

3.1.15**multi-switch loop through port**

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

Note 1 to entry: 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.

3.1.16**noise factor****noise figure**

figure of merit describing the internally generated noise of an active device

Note 1 to entry: 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.

$$F = \frac{C_1 N_1}{C_2 N_2}$$

where

C_1 is the signal power at the input;

C_2 is the signal power at the output;

N_1 is the noise power at the input (ideal thermal noise);

N_2 is the noise power at the output.

In other words, the noise factor is the ratio of noise power at the output of an active device to the noise power at the same point if the device had been ideal and added no noise.

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$$F = \frac{N_{2\text{actual}}}{N_{2\text{ideal}}}$$

The noise factor is dimensionless and is often expressed as noise figure, NF , in dB

$$NF = 10 \lg F \quad \text{in dB}$$

3.1.17**slope**

difference in gain or attenuation at two specified frequencies between any two points in an equipment or system

Note 1 to entry: The slope sign is considered



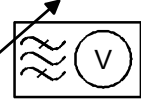




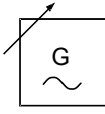















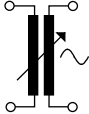

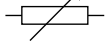


- negative when the attenuation increases with frequency (cables) or the gain (amplifiers) decreases with frequency,
- positive when the gain (amplifiers) increases with frequency (compensating slope).

3.1.18**surge voltage**

surge which is produced by a direct or indirect lightning stroke

3.2 Symbols

The following graphical symbols are used in the figures of this standard. These symbols are either listed in IEC 60617 or based on symbols defined in IEC 60617.

Symbols	Terms	Symbols	Terms
	Ammeter based on [IEC 60617-S00910 (2001-07)]		Voltmeter based on [IEC 60617-S00910 (2001-07)]
	Selective voltmeter		Power meter based on [IEC 60617-S00910 (2001-07)]
	Equipment under test based on [IEC 60617-S00059 (2001-07)]		Signal generator based on [IEC 60617-S00899, IEC 60617-S01403 (2001-07)]
	Noise generator [IEC 60617-S01230 (2001-07)]		Variable signal generator based on [IEC 60617-S00081, IEC 60617-S00899, IEC 60617-S01403 (2001-09)]
	Surge generator [IEC 60617-S01228 (2001-07)]		High-pass filter [IEC 60617-S01247 (2001-07)]
	Low-pass filter [IEC 60617-S01248 (2001-07)]		Band-stop filter [IEC 60617-S01250 (2001-07)]
	Band-pass filter [IEC 60617-S01249 (2001-07)]		Oscilloscope based on [IEC 60617-S00059, and IEC 60617-S00922 (2001-07)]
	Spectrum analyser (electrical) based on [IEC 60617-S00910 (2001-07)]		Attenuator based on [IEC 60617-S01244 (2001-07)]
	Variable attenuator [IEC 60617-S01245 (2001-07)]		Amplifier [IEC 60617-S01239 (2001-07)]
	RF modulator based on [IEC 60617-S01278 (2001-07)]		RF demodulator based on [IEC 60617-S01278 (2001-07)]
	Combiner based on [IEC 60617-S00059 (2001-07)]		Detector with LF-amplifier
	Functional equipotential bonding [IEC 60617-S01410 (2001-11)]		Adjustable AC voltage source
	Resistor [IEC 60617-S00555 (2001-07)]		Variable resistor [IEC 60617-S00557 (2001-07)]
	Capacitor [IEC 60617-S00567 (2001-07)]		RF choke [IEC 60617-S00583 (2001-07)]