

Cable networks for television signals, sound signals and interactive services —

Part 4: Passive wideband equipment for coaxial cable networks

ICS 33.060.40; 33.170

National foreword

This British Standard is the UK implementation of EN 60728-4:2008. It is identical to IEC 60728-4:2007. It supersedes BS EN 50083-4:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2008

© BSI 2008

ISBN 978 0 580 56972 2

Amendments/corrigenda issued since publication

Date	Comments

**Cable networks for television signals,
sound signals and interactive services -
Part 4: Passive wideband equipment for coaxial cable networks
(IEC 60728-4:2007)**

Réseaux de distribution par câbles
pour signaux de télévision,
signaux de radiodiffusion sonore
et services interactifs -
Partie 4: Equipements large bande passifs
relatifs aux réseaux câblés coaxiaux
(CEI 60728-4:2007)

Kabelnetze für Fernsehsignale,
Tonsignale und interaktive Dienste -
Teil 4: Passive Breitbandgeräte für
koaxiale Kabelnetze
(IEC 60728-4:2007)

This European Standard was approved by CENELEC on 2008-04-01. 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 two official versions (English and 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, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the 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 100/1243/FDIS, future edition 3 of IEC 60728-4, 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 was approved by CENELEC as EN 60728-4 on 2008-04-01.

This European Standard supersedes EN 50083-4:1998 + corrigendum January 1999.

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) 2009-01-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-04-01

For this European Standard the informative Annex B of IEC 60728-4:2007 shall be disregarded and has been replaced by the normative Annex ZB, *Special national conditions*; and the informative Annex ZC, *A-deviations*.

Annexes ZA, ZB and ZC have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60728-4:2007 was approved by CENELEC as a European Standard without any modification.

CONTENTS

INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms, definitions, symbols and abbreviations.....	7
3.1 Terms and definitions	7
3.2 Symbols	11
3.3 Abbreviations	12
4 Methods of measurement	12
4.1 Attenuation.....	12
4.1.1 Test equipment.....	12
4.1.2 Measurement procedure.....	12
4.1.3 Presentation of the results.....	13
4.2 Isolation	13
4.2.1 Definition	13
4.2.2 Test equipment.....	13
4.2.3 Measurement procedure.....	13
4.2.4 Presentation of the results.....	14
4.3 Through-loss	14
4.3.1 Definition	14
4.3.2 Test equipment.....	14
4.3.3 Measurement procedure.....	14
4.3.4 Presentation of the results.....	14
4.4 Group delay variation	14
4.4.1 Definition	14
4.4.2 Test equipment.....	14
4.4.3 Method of measurement	15
4.4.4 Presentation of the result.....	15
4.5 Amplitude frequency response	15
4.6 Return loss.....	15
4.7 Hum modulation of carrier	15
4.7.1 Definition	15
4.7.2 Description of the method of measurement.....	16
4.7.3 Measuring procedure.....	17
4.7.4 Calculating the hum-modulation ratio.....	18
4.7.5 Presentation of the results.....	19
4.8 Two-carrier intermodulation measurements for second- and third-order products	19
5 Performance requirements and recommendations	20
5.1 General performance requirements and recommendations	20
5.1.1 Safety.....	20
5.1.2 Electromagnetic compatibility (EMC)	20
5.1.3 Environmental	20
5.1.4 Marking	21
5.1.5 Impedance.....	21

5.1.6	Degradation of performance caused by overvoltages	21
5.2	Performance requirements and recommendations for receiver lead	21
5.3	Performance requirements and recommendations for system outlets	21
5.3.1	Safety	21
5.3.2	Quality grading	21
5.3.3	Mechanical requirements	22
5.3.4	Electrical parameters and requirements	22
5.4	Performance requirements and recommendations for splitters and taps	25
5.4.1	Description	25
5.4.2	Mechanical requirements for connectors	25
5.4.3	Electrical parameters and requirements	25
5.5	Performance requirements and recommendations for all other passive equipment	27
5.5.1	Description	27
5.5.2	Mechanical requirements for connectors	27
5.5.3	Electrical parameters and requirements	27
Bibliography		31
Annex A (informative)	Measurement errors which occur due to mismatched equipment	29
Annex B (informative)	Differences in some countries	30
Annex ZA (normative)	Normative references to international publications with their corresponding European publications	32
Annex ZB (normative)	Special national conditions	34
Annex ZC (informative)	A-deviations	35
Figure 1	– Test set-up for the measurement of attenuation	13
Figure 2	– Test set-up for the measurement of isolation	13
Figure 3	– Measurement of through-loss	14
Figure 4	– Carrier/hum ratio	15
Figure 5	– Test set-up for power injectors	16
Figure 6	– Test set-up for passive equipment, excluding power injectors	17
Figure 7	– Oscilloscope display	17
Figure 8	– Harmonic/Intermodulation test circuit	19
Figure 9	– Types of losses of system outlets	24
Figure A.1	– Error concerning return loss measurement	29
Figure A.2	– Maximum ripple	29
Table 1	– Return loss of system outlets	22
Table 2	– Return loss of looped-through system outlets	23
Table 3	– Maximum return path signal level derived from maximum allowed intermodulation distortion level in the downstream frequency band	25
Table 4	– Return loss of splitters and taps	25
Table 5	– Isolation of splitters	26
Table 6	– Return loss for all other passive equipment	27

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

- CATV¹-networks;
- MATV-networks and SMATV-networks;
- individual receiving networks;

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

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 networks used nowadays to provide telecommunications services, i.e. data, audio and video both broadcast and narrowcast.

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

Part 4: Passive wideband equipment for coaxial cable networks

1 Scope

This part of IEC 60728 applies to system outlets, splitters and taps, passive single or multiple port equipment comprising filters, attenuators, equalizers, galvanic isolators, power injectors, cable splices, terminating resistors and transfer points, but excluding coaxial cables and receiver leads (see 5.2).

This standard

- covers the frequency range 5 MHz to 3 000 MHz;
- identifies performance requirements for certain parameters;
- lays down data publication requirements for certain parameters;
- stipulates methods of measurements;
- introduces minimum requirements defining quality grades.

There are three grades for all passive equipment except system outlets where there is only one.

Different networks require the same performance and, when integrating networks, upgrading will be avoided.

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

All requirements and published data should be 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 60068 (all parts), *Environmental testing*

IEC 60417, *Graphical symbols for use on equipment*

NOTE IEC 60417 can be consulted on the IEC website.

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

IEC 60617, *Graphical symbols for diagrams*

IEC 60728 (all parts), *Cable networks for television signals, sound signals and interactive services*

NOTE The title of some of the parts of the IEC 60728 series will be changed when a new edition is published.

IEC 60966-1, *Radio frequency and coaxial cable assemblies – Part 1: Generic specification – General requirements and test methods*

IEC 60966-2-4, *Radio frequency and coaxial cable assemblies – Part 2-4: Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 to 3 000 MHz, IEC 61169-2 connectors*

IEC 60966-2-5, *Radio frequency and coaxial cable assemblies – Part 2-5: Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 to 1 000 MHz, IEC 61169-2 connectors*

IEC 60966-2-6, *Radio frequency and coaxial cable assemblies – Part 2-6: Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 to 3 000 MHz, IEC 61169-24 connectors*

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

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61169-1, *Radio-frequency connectors – Part 1: Generic specification – General requirements and measuring methods*

IEC 61169-2, *Radio-frequency connectors – Part 2: Sectional specification – Radio-frequency coaxial connectors of type 9,52*

IEC 61169-24, *Radio-frequency connectors – Part 24: Sectional specification – Radio-frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (type F)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

NOTE Some terms have been taken from IEC 60050-723.

3.1.1

active equipment

equipment (for example, amplifiers, converters, etc), performing signal processing by means of external or internal power supply in a certain frequency range

3.1.2

amplitude frequency response

gain or loss of an equipment or system plotted against frequency

3.1.3**attenuation**

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

3.1.4**decibel ratio**

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

$$10 \lg \frac{P_1}{P_2} \text{ dB} \quad (1)$$

3.1.5**directional coupler****tap**

passive signal splitting equipment, with minimum signal loss between the input port and the output port (through-loss), a specified coupling loss between the input port and the tap port (tap loss), and very high loss between the output port and tap port (isolation)

[IEV 723-09-25, modified]

3.1.6**directivity**

attenuation between output port and interface or tap port, minus the attenuation between input and interface or tap port, of any equipment or system

3.1.7**EM-active equipment**

all passive and active equipment carrying RF signals are considered as EM-active equipment, either because they are liable to cause electromagnetic disturbances or because the performance of them is liable to be affected by such disturbances

3.1.8**equalizer**

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

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

3.1.9**feeder**

transmission path forming part of a cable network. Such a path may consist of a metallic cable, optical fibre, wave guide or any combination of them. By extension, the term is also applied to paths containing one or more radio links

[IEV 723-09-12, modified]

3.1.10**grade**

classification of performance for equipment for use in cable networks. The choice of the appropriate grade depends on, for example,

- size of network;
- structure of network;
- lengths of cable between equipment;
- kind of services;

- kind of signals

NOTE In any case, the system performance requirement should be fulfilled by the design of the network and the choice of the grade of equipment used.

3.1.11

group delay variation

indicates the deviation from a linear phase-frequency response; the group delay is

$$\tau = \frac{d\varphi}{df} \quad (2)$$

where

φ is the phase;

f is the frequency.

Group delay variation (typically in ns) is the difference of the values of τ between the given frequency and the reference frequency

3.1.12

isolation

attenuation between two output, tap or interface ports of any equipment or system

3.1.13

level

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

$$10 \lg \frac{P_1}{P_0} \quad (3)$$

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

$$20 \lg \frac{U_1}{U_0} \quad (4)$$

NOTE This may be expressed in decibels (relative to 1 μV in 75 Ω) or more simply in dB(μV) if there is no risk of ambiguity.

3.1.14

looped system outlet

device through which the spur feeder passes and to which is connected a receiver lead, without the use of a subscriber's feeder

[IEV 723-09-21]

3.1.15

nominal value

reference value around which a certain tolerance field (plus/minus) is permitted or specified

3.1.16

passive equipment

equipment (for example, splitters, tap-offs, system outlets, etc.) not requiring a power supply in order to operate and/or not carrying out signal processing in a certain frequency range

3.1.17**receiver lead**

lead which connects the system outlet to the subscriber equipment

[IEV 723-09-23, modified]

NOTE 1 The meaning of receiver lead may not describe the function of this device if it is used for interactive subscriber equipment; the definition already gives the more general explanation and allows bi-directional services.

NOTE 2 A receiver lead may include filters and balun transformers in addition to the cable.

3.1.18**r.f. data port**

r.f. interface port to connect an interactive data equipment (for example, a modem) and passes return band (upstream), as well as distribution (downstream) frequency band

3.1.19**splice**

connecting device with barrel(s) accommodating electrical conductor(s) with or without additional provision to accommodate and secure the insulation

[IEV 581-05-11]

3.1.20**splitter**

equipment in which the signal power at the (input) port is divided equally or unequally between two or more (output) ports

NOTE This equipment may be used in the reverse direction for combining signal energy.

3.1.21**spur feeder**

feeder to which splitters, subscriber taps or looped system outlets are connected

[IEV 723-09-16, modified]

3.1.22**standard reference power and voltage**

in cable networks the standard reference power, P_0 , is 1/75 pW

NOTE This is the power dissipated in a 75 Ω resistor with an r.m.s voltage drop of 1 μ V across it.

The standard reference voltage, U_0 , is 1 μ V.

3.1.23**subscriber feeder**

feeder connecting a subscriber tap to a system outlet or, where the latter is not used, direct to the subscriber equipment

[IEV 723-09-17, modified]

NOTE A subscriber feeder may include filters and balun transformers.

3.1.24**subscriber tap**

equipment with one or more ports for connecting a subscriber feeder to a spur feeder

3.1.25**system outlet**

equipment for interconnecting a cable network and a receiver lead