

BS EN 60728-1:2014



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Cable networks for television signals, sound signals and interactive services

Part 1: System performance of forward paths

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National foreword

This British Standard is the UK implementation of EN 60728-1:2014. It is identical to IEC 60728-1:2014. It supersedes BS EN 60728-1:2008 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee EPL/100, Audio, video and multimedia systems and equipment, to Subcommittee EPL/100/4, Cable distribution equipment and systems.

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

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English Version

Cable networks for television signals, sound signals and
interactive services - Part 1: System performance of forward
paths
(IEC 60728-1:2014)

Réseaux de distribution par câbles pour signaux de
télévision, signaux de radiodiffusion sonore et services
interactifs - Partie 1: Caractéristiques des systèmes de voie
directe
(CEI 60728-1:2014)

Kabelnetze für Fernsehsignale, Tonsignale und interaktive
Dienste - Teil 1: Systemanforderungen in Vorwärtsrichtung
(IEC 60728-1:2014)

This European Standard was approved by CENELEC on 2014-06-27. 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.

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European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 100/2269/FDIS, future edition 5 of IEC 60728-1, 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 60728-1:2014.

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) 2015-03-27
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-06-27

This document supersedes EN 60728-1:2008.

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

For this European Standard the informative Annex K of IEC 60728-1:2014 shall be disregarded and has been replaced by the informative Annex ZB "A-deviations".

Annexes ZA and ZB have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60728-1:2014 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 Series	NOTE	Harmonized as EN 60728 Series (not modified).
IEC 61169-2	NOTE	Harmonized as EN 61169-2 (not modified).
IEC 61169-24	NOTE	Harmonized as EN 61169-24 (not modified).
CISPR 16-1 Series	NOTE	Harmonized as EN 55016-1 Series (not modified).
ISO/IEC 13818 Series	NOTE	Harmonized as EN ISO/IEC 13818 Series ¹⁾ (not modified).
ISO/IEC 13818-3	NOTE	Harmonized as EN ISO/IEC 13818-3 ¹⁾ (not modified).

¹⁾ Withdrawn.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When 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>
		Characteristics of DAB receivers	EN 50248	2001
IEC 60050-705	-	International Electrotechnical Vocabulary (IEV) - Chapter 705: Radio wave propagation	-	-
IEC 60050-712	1992	International Electrotechnical Vocabulary (IEV) - Chapter 712: Antennas	-	-
IEC 60050-725	-	International Electrotechnical Vocabulary (IEV) - Chapter 725: Space radiocommunications	-	-
IEC 60728-1-1	-	Cable networks for television signals sound signals and interactive services - Part 1-1: RF cabling for two way home networks	EN 60728-1-1	-
IEC 60728-1-2	-	Cable networks for television signals, sound signals and interactive services - Part 1-2: Performance requirements or signals delivered at the system outlet in operation	EN 60728-1-2	-
IEC 60728-2	-	Cable networks for television signals, sound signals and interactive services - Part 2: Electromagnetic compatibility for equipment	EN 50083-2	-
IEC 60728-3	2010	Cable networks for television signals, sound signals and interactive services - Part 3: Active wideband equipment for cable networks	EN 60728-3	2011
IEC 60728-5	-	Cable networks for television signals, sound signals and interactive services - Part 5: Headend equipment	EN 60728-5	-
IEC 60728-10	-	Cable networks for television signals, sound signals and interactive services - Part 10: System performance of return paths	EN 60728-10	-

IEC 60728-11	-	Cable networks for television signals, sound signals and interactive services - Part 11: Safety	EN 60728-11	-
IEC 60728-12	-	Cabled distribution systems for television and sound signals - Part 12: Electromagnetic compatibility of systems	EN 50083-8	-
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 MHz to 3 000 MHz, IEC 61169-2 connectors	EN 60966-2-4	-
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 MHz to 1 000 MHz, IEC 61169-2 connectors	EN 60966-2-5	-
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 MHz to 3 000 MHz, IEC 61169-24 connectors	EN 60966-2-6	-
ISO/IEC 13818-1	2007	Information technology - Generic coding of moving pictures and associated audio information: Systems		-
ISO/IEC 13818-4		Information technology - Generic coding of moving pictures and associated audio information - Part 4: Conformance testing		-
ISO/IEC 14496-1	-	Information technology - Coding of audio-visual objects - Part 1: Systems		-
ITU-R Recommendation BS.412-9	-	Planning standards for terrestrial FM sound-broadcasting at VHF		-
ITU-R Recommendation BT.417-4		Minimum field strengths for which protection may be sought in planning an analogue terrestrial television service		-
ITU-R Recommendation BT.470-7	-	Conventional analogue television systems		-
ITU-R Recommendation BT.500-11	-	Methodology for the subjective assessment-of the quality of television pictures		-
ITU-T Recommendation J.61	-	Transmission performance of television circuits designed for use in international connections		-

ETSI EN 300 421	-	Digital Video Broadcasting (DVB): Framing - structure, channel coding and modulation for 11/12 GHz satellite services	-
ETSI EN 300 429	-	Digital Video Broadcasting (DVB): Framing - structure, channel coding and modulation for cable systems	-
ETSI EN 300 468	-	Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems	-
ETSI EN 300 473	-	Digital Video Broadcasting (DVB): Satellite - Master Antenna Television (SMATV) distribution systems	-
ETSI EN 300 744	-	Digital Video Broadcasting (DVB): Framing - structure, channel coding and modulation for digital terrestrial television	-
ETSI EN 302 307/V1.3.1	2013	Digital Video Broadcasting (DVB); Second - generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2)	-
ETSI ETS 300 784	-	Satellite Earth Stations and Systems (SES);Television Receive-Only (TVRO) satellite earth stations operating in the 11/12 GHz frequency bands	-
ETSI TS 101 211	-	Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)	-
ETSI TS 102 831 V1.2.1	2012	Digital Video Broadcasting (DVB); Implementation guidelines for a second generation digital terrestrial television broadcasting system (DVB-T2)	-

Annex ZB (informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC national member.

This European Standard does not fall under any Directive of the EC.

In the relevant CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

Clause Deviation

3.1.58 Norway

According to Regulations on Electronic Communications Networks and Services (Ecom Regulations) laid down by the Norwegian Ministry of Transport and Communications on 16 February 2004, the following applies:

When installing coaxial cable-based networks, the part of the network to which the end-user is connected shall be placed in a star structure. It is not permitted to insert receiver connections into the connection between the star points.

5.4.1 Netherlands

(Dutch Technical Regulations for CATV networks (Technische Voorschriften voor Centrale Antenne Inrichtingen, 3e uitgave), 21 December 1977, which are valid for CATV networks in accordance with Article 21 of the Dutch Telecommunications law (Stb. 1988, 520))

Replace by/add the following “minimum and maximum carrier levels” regulation as indicated in Table ZB.1.

Table ZB.1 – Carrier signal levels at any system outlet

FM sound mono:	80 dB(μV) _{max}
----------------	--------------------------

(measured in accordance with CISPR 16-1 [4] (quasi-peak measurement within 120 kHz bandwidth))

5.6.2 Netherlands

(Dutch Technical Regulations for CATV networks (Technische Voorschriften voor Centrale Antenne Inrichtingen, 3e uitgave), 21 December 1977, which are valid for CATV networks in accordance with Article 21 of the Dutch Telecommunications law (Stb. 1988, 520))

Add the group delay response curve valid for PAL with FM-FM sound (Clause 5.4.1), as shown in Figure ZB.1.

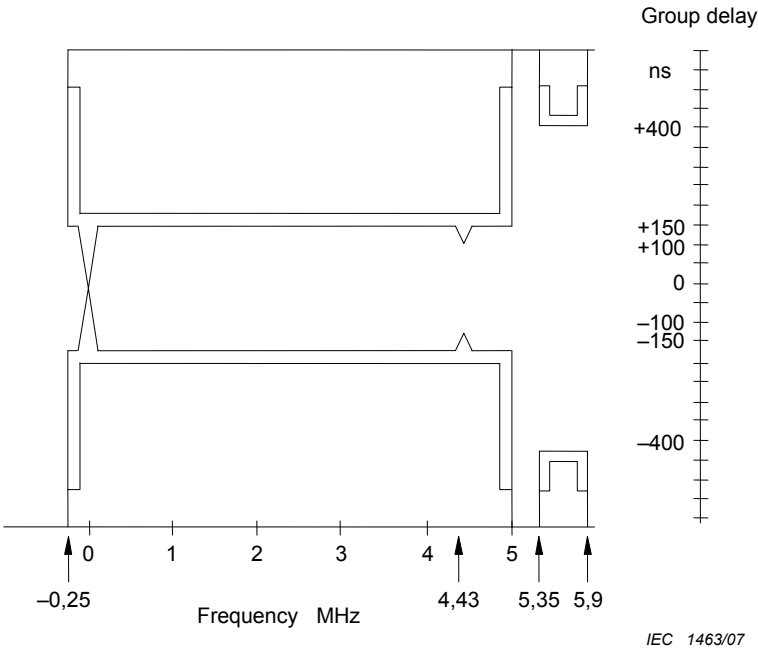


Figure ZB.1 – Mask group delay characteristic for PAL signals with FM-FM sound

5.9.1 Netherlands

(Dutch Technical Regulations for CATV networks (Technische Voorschriften voor Centrale Antenne Inrichtingen, 3e uitgave), 21 December 1977, which are valid for CATV networks in accordance with Article 21 of the Dutch Telecommunications law (Stb. 1988, 520))

Replace by/add the following “single-frequency interference” regulation as indicated in Table ZB.2.

Table ZB.2 – Single-frequency interference

AM-VSB-PAL-signals:	$C/I \geq 60$ dB	(measured in a bandwidth of 300 kHz)
For signals outside used TV channels:	$C/I \geq 40$ dB	

5.10.2 Netherlands

(Dutch Technical Regulations for CATV networks (Technische Voorschriften voor Centrale Antenne Inrichtingen, 3e uitgave), 21 December 1977, which are valid for CATV networks in accordance with Article 21 of the Dutch Telecommunications law (Stb. 1988, 520))

Replace the requirements for “echoes in television channels, PAL-SECAM standards” by the “requirement for echo loss in relation to the time delay of the reflected signal for AM-PAL-TV and FM-radio” (Figure ZB.2).

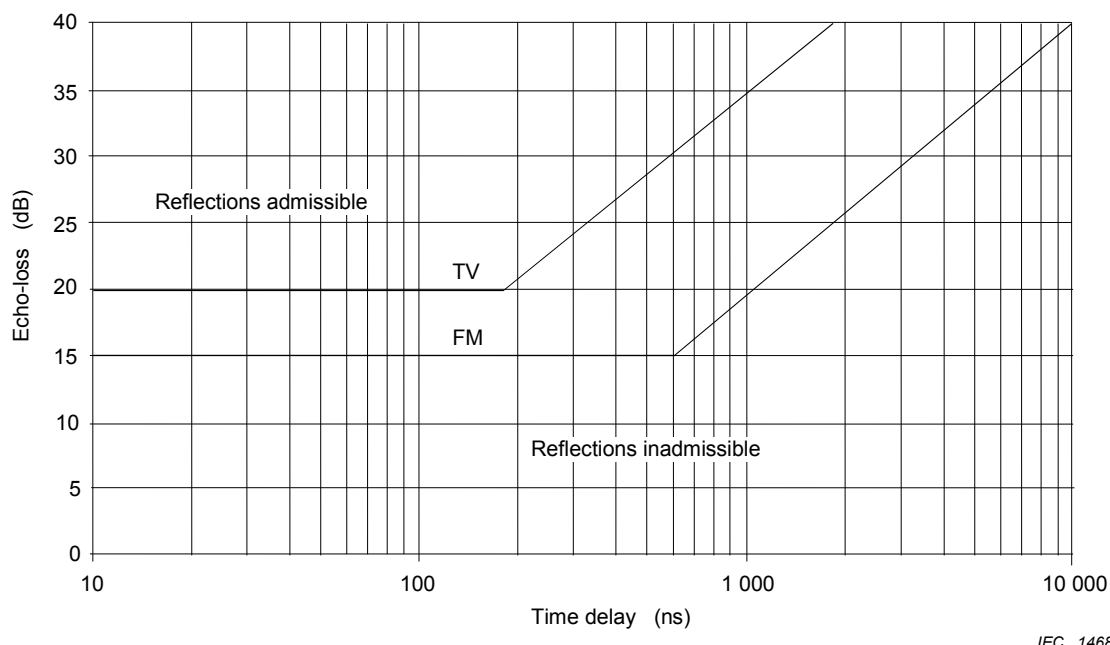


Figure ZB.2 – Requirement for echo loss in relation to the time delay of the reflected signal

5.12.1 Denmark

(Danish technical regulations for CATV-networks, which are applicable to those networks in accordance with national legislation act. nr; 277 of June 1995, given by the Ministry of Research)

Add the requirement for “decoding margin” being “the decoding margin must be 40 %, when the margin is a minimum of 70 % at the receiving antenna”.

5.14.3 Netherlands

(Dutch Technical Regulations for CATV networks (Technische Voorschriften voor Centrale Antenne Inrichtingen, 3e uitgave), 21 December 1977, which are valid for CATV networks in accordance with Article 21 of the Dutch Telecommunications law (Stb. 1988, 520))

Add the requirement for “adjacent channel spacing” by ≥ 400 kHz.

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INTRODUCTION

Standards and 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.

IEC 60728-1 includes the following clauses:

Clause 5 defines the system performance limits which will, with an unimpaired input, (headend input signal), produce picture and sound signals (at system outlets) where the impairment to any single parameter will not be worse, in normal operating conditions for any analogue channel, than grade four on the five-grade impairment scale contained in ITU- R Recommendation BT.500-10. For digitally modulated signals, the quality requirement is a quasi-error-free (QEF) reception.

Appropriate performance requirements for the signals at the receiving antennas site are given in Clause 6 in order to provide at the input of the headend of the cable network both analogue and digital television signals with suitable quality.

Clause 7 is applicable to home networks (including those of individual receiving systems) using coaxial cables, balanced cables or optical cables and primarily intended for television signals, sound signals and interactive services, operating between about 30 MHz and 3 000 MHz.

This clause (Clause 7), considering the basic operational characteristics of a home network, specifies the requirements with respect to the home network interface (HNI) taking into account the performance requirements given at the system outlet or at the terminal input.

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

Part 1: System performance of forward paths

1 Scope

This part of IEC 60728 is applicable to any cable network (including individual receiving systems) having in the forward path a coaxial cable output and primarily intended for television and sound signals operating between about 30 MHz and 3 000 MHz.

This part of IEC 60728 specifies the basic methods of measurement of the operational characteristics of cable network having coaxial cable outputs in order to assess the performance of these systems and their performance limits.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-705, *International Electrotechnical Vocabulary – Chapter 705: Radio wave propagation*

IEC 60050-712:1992, *International Electrotechnical Vocabulary – Chapter 712: Antennas*

IEC 60050-725, *International Electrotechnical Vocabulary (IEV) – Chapter 725: Space radiocommunications*

IEC 60728-1-1, *Cable networks for television signals, sound signals and interactive services – Part 1-1: RF cabling for two way home networks*

IEC 60728-1-2, *Cable networks for television signals sound signals and interactive services – Part 1-2: Performance requirements for signals delivered at the system outlet in operation*

IEC 60728-2, *Cable networks for television signals, sound signals and interactive services – Part 2: Electromagnetic compatibility for equipment*

IEC 60728-3:2010, *Cable networks for television signals, sound signals and interactive services – Part 3: Active wideband equipment for cable networks*

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

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

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

IEC 60728-12, *Cabled distribution systems for television and sound signals – Part 12: Electromagnetic compatibility of systems*

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 MHz 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 MHz 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 MHz to 3 000 MHz, IEC 61169-24 connectors*

ISO/IEC 13818-1:2007, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

ISO/IEC 13818-4, *Information technology – Generic coding of moving pictures and associated audio information – Part 4: Conformance testing*

ISO/IEC 14496-1, *Information technology – Coding of audio-visual objects – Part 1: Systems*

ITU-R Recommendation BS.412-9, *Planning standards for terrestrial FM sound broadcasting at VHF*

ITU-R Recommendation BT.417-4, *Minimum field strengths for which protection may be sought in planning an analogue terrestrial television service*

ITU-R Recommendation BT.470-7, *Conventional analogue television systems*

ITU-R Recommendation BT.500-11, *Methodology for the subjective assessment of the quality of television pictures*

ITU-T Recommendation J.61, *Transmission performance of television circuits designed for use in international connections*

EN 50248, *Characteristics of DAB receivers*

ETSI EN 300 421, *Digital Video Broadcasting (DVB) – Framing structure, channel coding and modulation for 11/12 GHz satellite services*

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

ETSI EN 300 468, *Digital Video Broadcasting (DVB) – Specification for Service Information (SI) in DVB systems*

ETSI EN 300 473, *Digital Video Broadcasting (DVB) – Satellite Master Antenna Television (SMATV) distribution systems*

ETSI EN 300 744, *Digital Video Broadcasting (DVB) – Framing structure, channel coding and modulation for digital terrestrial television*

ETSI EN 302 307/V1.3.1:2012, *Digital Video Broadcasting (DVB) – Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications*

ETSI ETS 300 784, *Satellite Earth Stations and Systems (SES) – TeleVision Receive-Only (TVRO) satellite earth stations operating in the 11/12 GHz frequency bands*

ETSI TR 101 211, *Digital Video Broadcasting (DVB) – Guidelines on implementation and usage of Service Information (SI)*

ETSI TS 102 831/V1.2.1:2012, *Digital Video Broadcasting (DVB) – Implementation guidelines for a second generation digital terrestrial television broadcasting system (DVB-T2)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-705, IEC 60050-712 and IEC 60050-725, as well as the following apply.

NOTE The most important definitions are repeated below.

3.1.1

active antenna

antenna incorporating active devices

[SOURCE: IEC 60050-712:1992, 712-03-29]

3.1.2

active home network

home network that uses active equipment (for example, amplifiers) in addition to passive equipment like splitters, taps, system outlets, cables and connectors up to the coaxial RF interface (input and/or output) of the terminal equipment for distributing and combining RF signals

3.1.3

antenna

part of a radio transmitting or receiving system which is designed to provide the required coupling between a transmitter or a receiver and the medium in which the radio wave propagates

Note 1 to entry: In practice, the terminals of the antenna or the points to be considered as the interface between the antenna and the transmitter or receiver should be specified.

Note 2 to entry: If the transmitter or receiver is connected to its antenna by a feeder line, the antenna may be considered to be a transducer between the guided radio waves of the feeder line and the radiated waves in space.

[SOURCE: IEC 60050-712:1992, 712-01-01, modified – The term feeder line instead of feed line has been used.]

3.1.4

antenna amplifier

amplifier (often a low-noise type) associated with an antenna

3.1.5

attenuation

ratio of the input power to the output power of an equipment or system

Note 1 to entry: The ratio is expressed in decibels.

3.1.6**automatic gain control****AGC**

automatic control of a device to maintain constant the level of the signal at its output, using that signal as the control stimulus

3.1.7**automatic level controlled amplifier**

amplifier which includes means to control automatically the level of the signal(s) at its output

Note 1 to entry: This may be achieved by controlling the variation of gain or slope or both, by means of

- one or more pilot carriers,
- a temperature sensing device,
- remote control.

3.1.8**backoff**

nominal difference of the lower level to a higher reference level

3.1.9**bit error ratio****BER**

ratio between erroneous bits and the total number of transmitted bits

3.1.10**branch amplifier**

amplifier to compensate for the attenuation in a branch feeder

3.1.11**branch feeder**

feeder used for connecting a distribution point to spur feeders

3.1.12**bridger amplifier**

amplifier for connection in a trunk or branch feeder to energize a distribution point or one or more branch or spur feeders

3.1.13**broadcast and communication technologies****BCT**

group of applications including RF distribution of sound signals and video signals

Note 1 to entry: For this standard, this is a group of applications using the HF band (3 MHz to 30 MHz), the VHF band (30 MHz to 300 MHz) and the UHF band (300 MHz to 3 000 MHz) for transmission of television signals, sound signals and interactive services, as well as for in-home inter-networking.

3.1.14**building network****BN**

network for transmission of television signals, sound signals and interactive services inside a building (multi-dwellings)

3.1.15**building network interface****BNI**

interface to the network for the transmission of television signals, sound signals and interactive services inside a building (multi-dwellings)

Note 1 to entry: This point is also called “transfer point” or “external network interface”.

3.1.16**carrier-to-intermodulation ratio****C/I**

difference between the carrier level at a specified point in a piece of equipment or a system and the level of a specified intermodulation product or combination of products

Note 1 to entry: The difference is given in decibels.

3.1.17**carrier-to-noise ratio****C/N**

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

Note 1 to entry: The difference is given in decibels.

3.1.18**CATV network**

regional and local broadband cable networks designed to provide sound and television signals as well as signals for interactive services to a regional or local area

Note 1 to entry: Originally defined as Community Antenna Television network.

3.1.19**combiner**

device in which signals arriving at two or more input ports are fed to a single output port

Note 1 to entry: Some forms of this device may be used in reverse direction as splitters.

3.1.20**composite intermodulation noise****CIN**

sum of noise and intermodulation products due to digitally modulated signals

3.1.21**composite intermodulation noise ratio****CINR**

difference between the signal level and the composite intermodulation noise (CIN) level

Note 1 to entry: The difference is given in decibels.

3.1.22**cross-modulation**

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

3.1.23**crossview**

effect on a wanted television signal of the undesired transfer of one or more television signal(s) from other circuit(s)

3.1.24**decibel ratio**

ten times the logarithm to base 10 of the ratio of two quantities of power P_1 and P_2 , i.e.

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

Note 1 to entry: This ratio may also be expressed in terms of voltages.

$$20 \lg \frac{U_1}{U_2} \text{ in dB}$$

3.1.25**designed receiving antenna**

antenna that has the gain, the directivity and the polarization for receiving the wanted signal at the headend site with the required performance

3.1.26**directional coupler**

passive signal splitting device, 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)

3.1.27**directivity**

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

3.1.28**distribution amplifier**

amplifier designed to feed one or more branch or spur feeders

Note 1 to entry: This is a general term embracing branch amplifier and spur amplifier.

3.1.29**distribution point**

point where signals are taken from the trunk feeder to energize branch and/or spur feeders

Note 1 to entry: In some cases, a distribution point may be directly connected to the headend.

3.1.30**DOCSIS****EuroDOCSIS**

standards defining interface specifications for cable modems and cable modem termination systems for high-speed data communication over RF cable networks

3.1.31**dwelling unit****DU**

home or office where television and sound signals are distributed and that provides access to interactive services

3.1.32 **E_b/N_0**

ratio between the energy per bit (E_b) and the noise power density (N_0)

3.1.33**echo rating** **E**

result of a system test with a $2T$ sine-squared pulse using the boundary line on a specified graticule within which all parts of the received pulse fall

EXAMPLE See Figure 25.

Note 1 to entry: Echo rating is determined in ITU-T Recommendation J.61 and ITU-T Recommendation J.63.

Note 2 to entry: The object of the graticule design is to ensure that the subjective effect of an echo of rating E % is the same as that of a single echo, with displacement greater than $12T$, of $(E/2)$ % relative to the peak amplitude of the test pulse.

3.1.34**equaliser**

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

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

3.1.35**extended satellite television distribution network or system**

distribution network or system designed to provide sound and television signals received by satellite receiving antenna to households in one or more buildings

Note 1 to entry: This kind of network or system can be combined with terrestrial antennas for the additional reception of TV and/or radio signals via terrestrial networks.

Note 2 to entry: This kind of network or system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.36**extended terrestrial television distribution network or system**

distribution network or system designed to provide sound and television signals received by terrestrial receiving antennas to households in one or more buildings

Note 1 to entry: This kind of network or system can be combined with a satellite antenna for the additional reception of TV and/or radio signals via satellite networks.

Note 2 to entry: This kind of network or system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.37**FECFRAME**

frame processed by the FEC coding subsystem

3.1.38**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.

Note 2 to entry: By extension, the term is also applied to paths containing one or more radio links.

3.1.39**frequency amplitude response**

gain or loss between two ports of an equipment or system plotted against frequency

3.1.40**frequency converter**

device for changing the carrier frequency of one or more signals

3.1.41**frequency designations**

frequency designations and abbreviations of IEC 60050-713 to be used in relation to cable networks

Note 1 to entry: For example, a VHF system includes frequencies between 30 MHz and 300 MHz.

3.1.42**gain**

ratio of the output power to the input power of any equipment or system

Note 1 to entry: The gain is expressed in decibels.

3.1.43**headend**

equipment which is connected between receiving antennas or other signal sources and the remainder of the cable networks, to process the signals to be distributed

Note 1 to entry: The headend may, for example, comprise antenna amplifiers, frequency converters, combiners, separators and generators.

3.1.44**headend for individual reception**

headend supplying an individual household

Note 1 to entry: This type of installation may include one or more system outlets.

3.1.45**headend input**

interface of a headend where the signals received by antennas or individual feeder lines are applied for signal processing

3.1.46**home cable link****HCL**

physical link (cable) between the home distributor (HD) and the system outlet or the terminal input

3.1.47**home distributor****HD**

distributor within a home where cables terminate

3.1.48**home network****HN**

RF cable network inside a single dwelling (one-family house or one unit of a multi-dwelling building) in the SOHO (Small Offices Home Offices) environments or in the rooms of hotels, and hospitals

Note 1 to entry: The preferred topology of this network is a star.

Note 2 to entry: This network carries television signals, sound signals and interactive services up to the coaxial RF interface (input and/or output) of the terminal equipment. It may comprise active equipment, passive equipment, cables and connectors.

3.1.49**home network interface****HNI**

interface for access to the network for transmission of television signal, sound signals and interactive services inside a home (single dwelling)

3.1.50**hub headend**

headend used to feed the entire operating network in the service area

3.1.51**individual satellite television receiving system**

system designed to provide sound and television signals received from satellite(s) to an individual household

Note 1 to entry: This kind of system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.52**individual terrestrial television receiving system**

system designed to provide sound and television signals received via terrestrial broadcast networks to an individual household

Note 1 to entry: This kind of system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.53**intermodulation**

process whereby non-linearity of equipment in a system produces output signals (called intermodulation products) at frequencies which are linear combinations of those of the input signals

3.1.54**isolation**

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

3.1.55**3.1.55.1****level**

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

$$10 \lg \frac{P_1}{P_0} \quad \text{in dB}$$

Note 1 to entry: The ratio is given in decibel (dB).

Note 2 to entry: 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.

3.1.55.2**level**

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

$$20 \lg \frac{U_1}{U_0} \quad \text{in dB}$$

Note 1 to entry: The ratio is given in decibel (dB).

Note 2 to entry: 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.

3.1.56**local broadband cable network**

network designed to provide sound and television signals as well as signals for interactive services to a local area (e.g. one town or one village)

3.1.57**local headend**

headend which is connected directly to the system trunk feeders or to a short-haul trunk feeder replacement link

3.1.58**looped system outlet**

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

Note 1 to entry: For special conditions in Norway, see Clause K.1.

3.1.59**MATV headend**

headend used in blocks of flats and in built-up sites to feed TV channels and FM radio channels into the house network or the spur network

3.1.60**MATV network**

extended terrestrial television distribution networks or systems designed to provide sound and television signals received by terrestrial receiving antennas to households in one or more buildings

Note 1 to entry: Originally defined as Master Antenna Television network.

Note 2 to entry: This kind of network or system can be combined with a satellite antenna for the additional reception of TV and/or radio signals via satellite networks.

Note 3 to entry: This kind of network or system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.61**modulation error ratio****MER**

sum of the squares of the magnitudes of the ideal symbol vectors divided by the sum of the squares of the magnitudes of the symbol error vectors of a sequence of symbols

Note 1 to entry: The result being expressed as a power ratio in decibel, as follows.

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

3.1.62**MPEG-2**

refers to the ISO/IEC 13818 series of standards

Note 1 to entry: For system coding, see ISO/IEC 13818-1; for video coding, see ISO/IEC 13818-2; for audio coding, see ISO/IEC 13818-3.

3.1.63**MPEG-4**

refers to the ISO/IEC 14496 series of standards

Note 1 to entry: For system coding, see ISO/IEC 14496-1; for video coding, see ISO/IEC 14496-2; for audio coding, see ISO/IEC 14496-3.

3.1.64**multi dwelling unit****MDU**

building with many homes or offices used by single owners where television signals, sound signals are distributed and with access to interactive services

3.1.65**multiplex**

signals from several separate sources assembled into a single composite signal for transmission over a common transmission channel

[SOURCE: IEC 60050-701:1988, 701-03-09, modified – Term and definition have been changed to describe the result of the multiplexing process.]

3.1.66**mutual isolation**

attenuation between two specified system outlets at any frequency within the range of the system under investigation which is always specified, for any particular installation, as the minimum value obtained within specified frequency limits

3.1.67**network interface****NI**

interface to the network for transmission of television signals, sound signals and interactive services

3.1.68**network termination unit****NTU**

equipment for access to the cable network for television signal, sound signals and interactive services

3.1.69**outdoor unit**

part of the TVRO installed in a position within line of sight to the satellite(s) to be received

Note 1 to entry:

An outdoor unit normally comprises two main parts:

- a) the antenna sub-system which converts the incident radiation field into a guided wave;
The antenna sub-system consists of
 - the main reflector, the secondary reflectors (if any) and the radiator,
 - the feeder network, which may include optional polarizing devices, to receive orthogonal linear polarizations, in a simultaneous or exclusive way.

Instead of reflector(s)/feed network subsystem, other types of antennas may be used, for example, flat array antennas;

- b) the LNB(s), which may include an optional filter, is/are a device(s) with very low internal noise that amplifies the received signals in the RF band and converts them to intermediate frequencies, (often called the 1st IF), for transmission to one or more indoor units where tuning, demodulation and decoding of the received signals are performed.

3.1.70**out-of-band emissions**

emissions on a frequency or on frequencies outside the necessary bandwidth resulting from the modulation process, but excluding spurious emissions

3.1.71**permanent link**

transmission path between any two test interfaces within a cabling subsystem link including the connecting hardware at each end

3.1.72**phase noise**

phase instability of random nature

Note 1 to entry: The sources of random sideband noise in an oscillator are thermal noise, flicker noise and shot noise.

Note 2 to entry: Each time the signal is frequency processed this signal is degraded by an addition of phase noise due to phase noise of the local oscillator. Frequency converters or modulators generate phase noise.

3.1.73**programme-specific information****PSI**

coding specification describing the content of the transport stream packets for the purpose of demultiplexing and the presentation of programmes, as defined in ISO/IEC 13818-1:2007

3.1.74**receiver lead**

lead which connects the system outlet to the subscriber's equipment

Note 1 to entry: A receiver lead may include filters and balun transformers in addition to the cable.

3.1.75**regional broadband cable network**

network designed to provide sound and television signals as well as signals for interactive services to a regional area covering several towns and/or villages

3.1.76**remote headend**

headend from which signals are delivered to a local headend via a long-distance terrestrial link

3.1.77**satellite master antenna television system****SMATV**

system which is designed to provide sound and television signals to the outlets of a building or a group of buildings

Note 1 to entry: Two system configurations are defined in ETSI EN 300 473 as follows:

- SMATV system A, based on transparent transmodulation of QPSK satellite signals into QAM signals to be distributed to the user;
- SMATV system B, based on direct distribution of QPSK signals to the user, with two options:
 - SMATV-IF distribution in the satellite IF band (above 950 MHz);
 - SMATV-S distribution in the VHF/UHF band, for example in the extended S band (230 MHz to 470 MHz).

3.1.78**separator**

device in which the signal energy, covering a frequency band, at one input port is divided between two or more output ports each of which covers a part of that frequency band

Note 1 to entry: For example, a diplexer is a two-output separator.

Note 2 to entry: Some forms of this device may be used in the reverse direction for combining.

3.1.79**service information****SI**

digital data describing the delivery system, content and scheduling/timing of broadcast data streams, etc.

Note 1 to entry: It includes MPEG-2 programme-specific information (PSI) together with independently defined extensions.

3.1.80 **$S_{D,RF}/N$**

signal-to-noise ratio for a digitally modulated signal in the RF band

3.1.81**single dwelling unit****SDU**

home or office used by a single owner where television signals and sound signals are distributed and with access to interactive services

3.1.82**signal adaptor**

device which modifies the input signal to achieve conformity with the appropriate ITU system, without changing the baseband characteristics, for use in a cable network which distributes television signals not conforming to any ITU system (only in respect of the RF structure)

3.1.83**signal tilt**

difference in level deliberately established between specified signals at any point in a system

Note 1 to entry: If groups of signals are established at differing levels, this is referred to as block tilt.

3.1.84**shoulder attenuation**

ratio between signal and spectrum re-growth outside the channel

3.1.85**slope**

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

3.1.86**SMATV headend**

headend in block of flats or in built-up sites to feed TV channels received by satellite into the house network or the spur network

Note 1 to entry: In some cases, a distribution point may be connected directly to the headend.

3.1.87**SMATV network**

extended distribution networks or systems designed to provide sound and television signals received by satellite receiving antenna to households in one or more buildings

Note 1 to entry: Originally defined as satellite master antenna television network.

Note 2 to entry: This kind of network or system can be combined with terrestrial antennas for the additional reception of TV and/or radio signals via terrestrial networks.

Note 3 to entry: This kind of network or system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.88**splitter****spur unit**

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

Note 1 to entry: Some forms of this device may be used in the reverse direction for combining signal energy.

3.1.89**spur amplifier****line extender**

amplifier to compensate for the attenuation in a spur feeder

3.1.90**spur feeder**

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

3.1.91**spurious emissions**

emissions on a frequency or frequencies which are outside the necessary bandwidth and whose level may be reduced without affecting the corresponding transmission of information

Note 1 to entry: Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions.

3.1.92**standard reference power**

P_0

<in cable networks> 1/75 pW

Note 1 to entry: This is the power dissipated in a 75 Ω resistor with a voltage drop of 1 μV_{RMS} across it.

3.1.93**subscriber feeder**

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

Note 1 to entry: A subscriber feeder may include filters and balun transformers.

3.1.94**subscriber equipment**

equipment at the subscriber premises such as receivers, tuners, decoders, video recorders

3.1.95**subscriber tap**

device for connecting a subscriber feeder to a spur feeder

3.1.96**subscriber terminal**

ST

equipment able to receive the distributed signals or to send (via a cable modem) return signals for interactive services

EXAMPLE Television receiver, radio receiver, set-top box, etc.

3.1.97**supertrunk feeder**

connects only between headends or between a headend and the first distribution point

3.1.98**symbol rate stability**

short-term variation of symbol rate due to signal processing

EXAMPLE Zero packet stuffing in headend equipment.

3.1.99**system outlet**

SO

device for interconnecting a subscriber feeder and a receiver lead

3.1.100**transport stream****TS**

data structure defined in ISO/IEC 13818-1:2007

Note 1 to entry: It is the basis of the digital video broadcasting (DVB) related standards.

3.1.101**trunk feeder**

feeder used for the transmission of signals between a headend and a distribution point or between distribution points

3.1.102**trunk amplifier**

amplifier to compensate for the attenuation in a trunk feeder

3.1.103**trunk-bridger amplifier**

amplifier to compensate for the attenuation in a trunk feeder and also to energize a distribution point

3.1.104**unwanted emissions**

include spurious emissions and out-of-band emissions

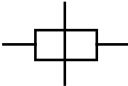
3.1.105**well-matched**

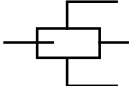
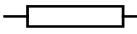
matching condition when the return loss of the equipment complies with the requirements of Table 1 of IEC 60728-3:2010

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
	attenuator [IEC 60617-S01244 (2001:07)]		variable attenuator [IEC 60617-S01245 (2001:07)]
	sine-wave generator [IEC 60617-S01226 (2001:07)]		low pass filter [IEC 60617-S01248 (2001:07)]
	band pass filter [IEC 60617-S01249 (2001:07)]		Variable band-pass filter [IEC 60617-S01249 (2001:07)] [IEC 60617-S00081 (2001:07)]
	amplifier [IEC 60617-S01239 (2001:07)]		detector
	oscilloscope [IEC 60617-S00059 (2001:07)] [IEC 60617-S00922 (2001:07)]		spectrum analyser [IEC 60617-S00059 (2001:07)] [IEC 60617-S00910 (2001:07)]
	directional coupler [IEC 60617-S01340 (2001:07)]		mixer
	modulator [IEC 60617-S01278 (2001:07)]		demodulator [IEC 60617-S01278 (2001:07)]
	Home Network Interface (HNI)		System Outlet (SO) [IEC 60617-S00438 (2001:07)]

Symbols	Terms
	subscriber tap
	Receiver lead
	RF-choke [IEC 60617-S00583 (2001:07)]

Symbols	Terms
	splitter
	resistor [IEC 60617-S00555 (2007:01)]

3.3 Abbreviations

AC	alternating current	AFC	automatic frequency control
AGC	automatic gain control	AI	amplitude imbalance
ALC	automatic level control	AM	amplitude modulation
ANT_C	antenna coefficient	APSK	amplitude and phase shift keying
ASCII	American standard code for information interchange	ATM	asynchronous transfer mode
AWGN	additive white Gaussian noise	BAT	bouquet association table
BCH	Bose-Chaudhuri-Hocquenghem multiple error correction binary block code	BCT	broadcast and communication technologies
BCT B	BCT supported by balanced cabling	BCT C	BCT supported by coaxial cabling
BEP	bit error probability	BER	bit error ratio
BICM	bit interleaved and code modulation	BPSK	binary phase shift keying
bslbf	bit string, left bit first	BW	bandwidth
C/N	carrier-to-noise ratio (ratio of RF or IF power to noise power)	CA	conditional access
CATV	community antenna television	CENELEC	Comité Européen de Normalisation Electrotechnique
CEPT	Conférence Européenne des Administrations des Postes et des Télécommunications	COFDM	coded orthogonal frequency division multiplex
CPE	common phase error	CRC	cyclic redundancy check
CS	carrier suppression	CSO	composite second order
CTB	composite triple beat	CW	continuous wave
D/A	digital-to-analogue converter	DAB	digital audio broadcasting
DC	direct current	DFT	discrete Fourier transformation
DOCSIS	Data Over Cable Service Interface Specification	DTH	direct to home
DVB	digital video broadcasting	DVB-C	digital video broadcasting baseline system for digital cable television (ETSI EN 300 429)
DVB-CS	digital video broadcasting baseline system for SMATV distribution systems (ETSI EN 300 473)	DVB-MC	digital video broadcasting baseline system for multi-point video distribution systems below 10 GHz (ETSI EN 300 749)
DVB-MS	digital video broadcasting baseline system for multi-point video distribution systems at 10 GHz and above (ETSI EN 300 748)	DVB-S	digital video broadcasting baseline system for digital satellite television (ETSI EN 300 421)
DVB-S2	digital video broadcasting baseline system for digital satellite television second generation (ETSI EN 302 307/ V1.3.1:2012)	DVB-T	digital video broadcasting baseline system for digital terrestrial television (ETSI EN 300 744)

DVB-T2	digital video broadcasting baseline system for digital terrestrial television second generation (ETSI EN 302 755)	EB	error block
EIT	event information table	EMM	entitlement management message
EN	European norm	ENB	equivalent noise bandwidth
END	equivalent noise degradation	ETR	ETSI technical report
ETS	European telecommunications standard	ETSI	European Telecommunications Standards Institute
Euro DOCSIS	European Data Over Cable Service Interface Specification	FDM	frequency division multiplex
FEC	forward error correction	FFT	fast Fourier transform
FIFO	first-in, first-out shift register	FM	frequency modulation
FSL	field strength level	HBES	home and building electronic systems
HCL	home cable link	HD	home distributor
HDTV	high-definition television	HES	home electronic systems
HEX	hexadecimal notation	HN	home network
HNI	home network interface	HP	high priority bit stream
ICI	inter-carrier interference	IF	intermediate frequency
IFFT	inverse fast Fourier transform	IRE	Institute of Radio Engineers
ITS	insertion test signal	ITU	International Telecommunication Union
LDPC	low-density parity check (codes)	LDTV	low-definition television
LNB	low noise block converter (frequency converter in the focal point of a parabolic antenna)	LO	local oscillator
LP	low-priority bit stream	LSB	least significant bit
MATV	master antenna television	MDU	multi-dwelling unit
MER	modulation error ratio	MMDS	microwave multipoint distribution systems
MoCA	multimedia over cable alliance	MPEG	moving picture experts group
MSB	most significant bit	MSPS	mega symbols per second
MUX	multiplex	MVDS	microwave video distribution systems
NICAM	near-instantaneously companded audio multiplex	NM	noise margin
NTSC	national television system committee	OCT	octal notation
OFDM	orthogonal frequency division multiplex	PAL	phase alternation line
PAPR	peak-to-average power ratio	PCR	programme clock reference
PER	packet error ratio	PID	packet identifier
PLP	physical layer pipe	PRBS	pseudo-random binary sequence
PSK	phase shift keying	QAM	quadrature amplitude modulation

QEF	quasi-error-free	QPSK	quaternary phase shift keying
RF	radio frequency	RMS	root mean square
RS	Reed-Solomon	RSBW	resolution bandwidth
SDTV	standard definition television	SDU	single dwelling unit
SECAM	séquentiel couleur à mémoire	SFN	single frequency network
SMATV	satellite master antenna television	SO	system outlet
SOHO	small office, home office	SSLA	sectional slope of active coaxial home network
SSLP	sectional slope of passive coaxial home network	T-STD	Standard television
TC8PSK	trellis coded 8-phase shift keying	TI	terminal input
TPS	transmission parameter signalling	TS	transport stream
TV	television	TVRO	television receive only
UHF	ultra-high frequency	uimsbf	unsigned integer, most significant bit first
UTC	universal time coordinated	VHF	very high frequency
VSB	vestigial side band	WiFi	Wireless Fidelity

4 Methods of measurement at system outlet

4.1 Performance limits

All requirements refer to the performance limits, which shall be obtained between the input(s) to the headend or headends and any system outlet when terminated in a resistance equal to the nominal load impedance of the system, unless otherwise specified. Where system outlets are not used, the above applies at the subscriber's end of the subscriber's feeder. Also, requirements which are obtained between the input(s) to the headend or headends and any home network interface (HNI) are given.

The methods of measurement described in this standard are considered basic. However, any equivalent method that ensures at least the same accuracy may be used. Also note that, if the system operator wishes to subdivide the system into a number of parts or wishes to use different transmission media (for example, coaxial cabling, balanced cabling, optical cabling), the accumulation of degradations should not exceed the figures given in this standard.

System performance requirements of return paths as well as specific methods of measurement for the use of the return paths in cable networks are described in IEC 60728-10.

The methods of measurement listed below are applicable to analogue and/or digitally modulated carriers as indicated in Table 1.

Table 1 – Application of the methods of measurement

Methods of measurement	Modulation of carriers									
	Analogue					Digital				
	Television				Radio FM	Television				Radio
	Vision carrier AM-VSB			Vision and sound carriers FM	TV sound carrier FM/AM	Vision and sound DVB			Sound	
Subclause reference	NTSC	PAL	SECAM			PSK, APSK	QAM	OFDM	NICAM	DAB
4.2 Mutual isolation between system outlets	X	X	X	X	X	X	X	X	X	X
4.3 Amplitude response within a channel	X	X	X	X	X	X	X	X	X	X
4.4 Chrominance-luminance gain and delay inequalities		X	X							
4.5 Non-linear distortion	X	X	X	X	X		X			
4.6 Carrier-to-noise ratio	X	X	X	X	X					
4.7 Echoes	X	X	X							
4.8 AM-VSB television, FM radio and FM television signal level	X	X	X	X	X					
4.9 Data echo rating and data delay inequality	X	X	X							
4.10 Interference in FM sound radio channels					X					
4.11 Methods of measurement for digitally modulated signals						X	X	X		
4.11.3 Signal level for digitally modulated signals						X	X	X		X
4.11.4 RF signal-to-noise ratio $S_{D,RF}/N$ for digitally modulated signals						X	X	X		X
4.11.5 Bit error ratio (BER)						X	X	X		X
4.11.6 BER versus E_b/N_0 or C/N						X	X	X		X
4.11.7 Noise margin						X	X	X		X
4.11.8 Modulation error ratio (MER)						X	X			
4.11.9 Phase jitter						X	X			
4.11.10 Phase noise of an RF carrier						X	X	X		X

4.2 Mutual isolation between system outlets

4.2.1 Overview

Although the method described applies also to the far ends of subscriber feeders when no system outlets are used, isolation will usually be measured between

- a) system outlets connected to adjacent subscriber taps,
- b) system outlets connected to the same multiple subscriber tap,
- c) adjacent looped system outlets.

4.2.2 Equipment required

The test set-up shall be well-matched and shall consist of

- a) a sweep frequency generator, with frequency range or ranges to suit the system to be examined, equipped with a frequency marking system,
- b) a terminating wideband detector,

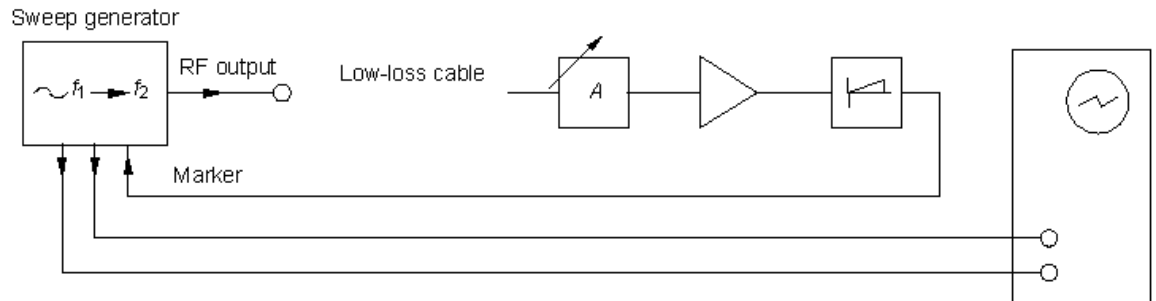
NOTE 1 "Wideband" is understood to mean of sufficient bandwidth to cover the full frequency range of the system under investigation.

NOTE 2 Some sweep frequency generators may include a terminating wideband detector.

- c) a variable attenuator, adjustable in steps of not more than 1 dB up to a value greater than the maximum mutual isolation to be measured,
- d) a wideband amplifier with sufficient gain to raise the signal level at the system outlet to a level suitable to drive the detector,
- e) an oscilloscope or other display unit suitable for operation with the sweep frequency generator,
- f) a suitable coaxial cable of sufficient length to reach from one system outlet to an adjacent one in the cable network.

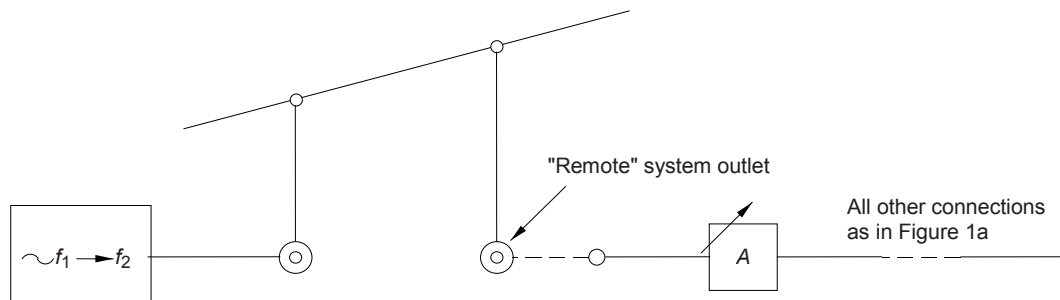
4.2.3 Connection of the equipment

The pieces of equipment shall be connected as in Figure 1.



IEC 1719/14

Figure 1a



IEC 1720/14

Figure 1b

Figure 1 – Arrangement of test equipment for measurement of mutual isolation between system outlets

4.2.4 Measurement procedure

The measurement procedure consists of the following steps.

- With the equipment connected as shown in Figure 1a, set the variable attenuator to a value just greater than the maximum value of mutual isolation expected to be measured. Note this value a_1 .
- Adjust the output level of the sweep generator to give a level at the input to the amplifier approximately equal to that available at a system outlet.
- Adjust the oscilloscope and amplifier gain controls to produce a display and note the amplitude a_1 of the display over the frequency range under inspection.
- Remove from the section under test, the signals normally distributed on the system whilst maintaining the correct terminating conditions; connect the equipment as shown in Figure 1b. Note that the output from the sweep generator is connected to the "local" system outlet and the long cable (according to 4.2.2 f)) is used to connect to the "remote" outlet.
- Reduce the attenuator setting until the peak of the display just reaches the same amplitude as that noted in item c) of this subclause for the frequency at which the peak occurs.
- Note the new value of the attenuator a_2 .
- Mutual isolation is given by $a_1 - a_2$.

- h) If the system outlets are of dual socket design, for example, TV and radio, the mutual isolation should also be measured at the appropriate frequencies between one socket, for example TV, of the "local" system outlet and the alternate socket, for example, radio, of the "remote" system outlet, and vice versa. In these cases, it will be necessary also to measure mutual isolation with the unused sockets in both terminated and open-circuit conditions. The conditions of measurement should be stated when tabulating results. When unused sockets are terminated, the terminating resistance shall be 75 Ω .
- i) Where the measurements are made in a number of discrete frequency bands, the lowest result obtained shall be taken as the mutual isolation between the two system outlets under investigation.

4.2.5 Presentation of the results

The results shall be presented in a table listing the values obtained for each couple of measured system outlets.

4.3 Amplitude response within a channel

4.3.1 Overview

The method described is applicable to the measurement of the amplitude response of cable networks over the frequency range of an individual channel between two specified points within the system.

However, where input signals to the system are received at, or are reduced to, baseband, and modulated onto the system carrier frequencies, the response of any demodulator and modulator shall not be included. If it is required to include the characteristics of these items, a separate assessment shall be made using test techniques applicable to such equipment.

Where the system contains frequency changing equipment between the antenna input and the system outlet at which the tests are to be made, the calibration of the equipment (as detailed in 4.2.4a) to 4.2.4g)) shall be carried out at the output frequencies, having first checked that the output of the sweep frequency generator is also flat over the input channel.

4.3.2 Equipment required

The test set-up shall be well-matched and shall consist of

- a) a sweep frequency generator,
- b) a terminating RF detector,
- c) two variable attenuators,
- d) an amplifier,
- e) a dual-trace oscilloscope,
- f) a high output (at least 300 mV_{RMS} terminated) signal generator of known frequency calibration over the frequency range of the channel to be tested,
- g) a balanced mixer,
- h) a low-pass filter with cut-off at approximately 200 kHz for television channels or approximately 10 kHz for FM sound radio,
- i) a directional coupler suitable for use in the frequency range of the channel to be tested,
- j) a termination to match the output of the filter specified in item h) of this subclause.

4.3.3 Connection of the equipment

The equipment shall be connected as in Figure 2a. If the tests shall be carried out in the presence of other signals on the system, a filter may be necessary at the input of the amplifier to prevent distortion of the display. This filter shall have a flat response and shall match the system correctly over the channel to be tested. It shall have sufficient attenuation to

frequencies of the other signals to reduce them to about 20 dB below the level of the swept test signal.

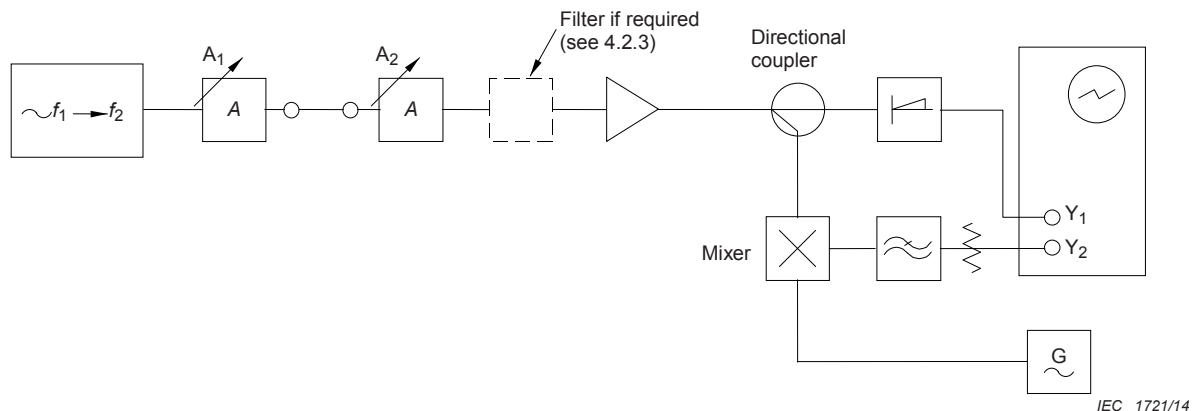


Figure 2a

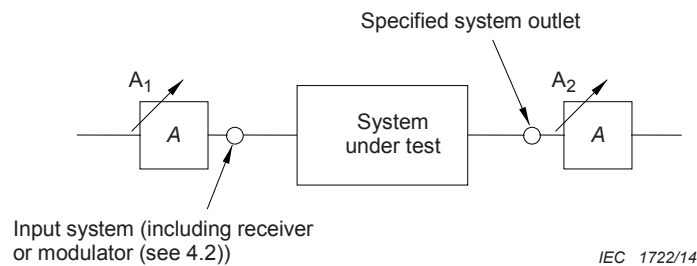


Figure 2b

Figure 2 – Arrangement of test equipment for measurement of frequency response within a channel

4.3.4 Measurement procedure

The measurement procedure consists of the following steps.

- With the equipment connected as shown in Figure 2a, adjust the output frequencies of the sweep generator to cover the channel to be tested and set the variable attenuator A_1 , so that the level of the signal at its output is that which will be required when connected to the system input.
 - Set the variable attenuator A_2 , so that the level of the signal at the input to the amplifier is about 3 dB to 4 dB below that expected at the system outlet at which the test will be carried out.
 - Adjust the oscilloscope controls to obtain a satisfactory display on the Y_1 channel, which shall be DC coupled, locking the timebase to the leading edge of the display.
- NOTE 1 It may be necessary to operate the oscilloscope at a repetition rate equal to half that of the sweep generator and examine the "second" displayed response.
- Adjust the frequency of the signal generator to that of the lower limit of the channel under investigation and arrange the level of this signal and the gain and shift controls of the Y_2 channel of the oscilloscope to produce a satisfactory "marker".
 - Move the "marker" to the upper frequency limit of the channel and carefully note the amplitude of the display between the two marks (see "reference" in Figure 3) and the level of the display during the blanking period.

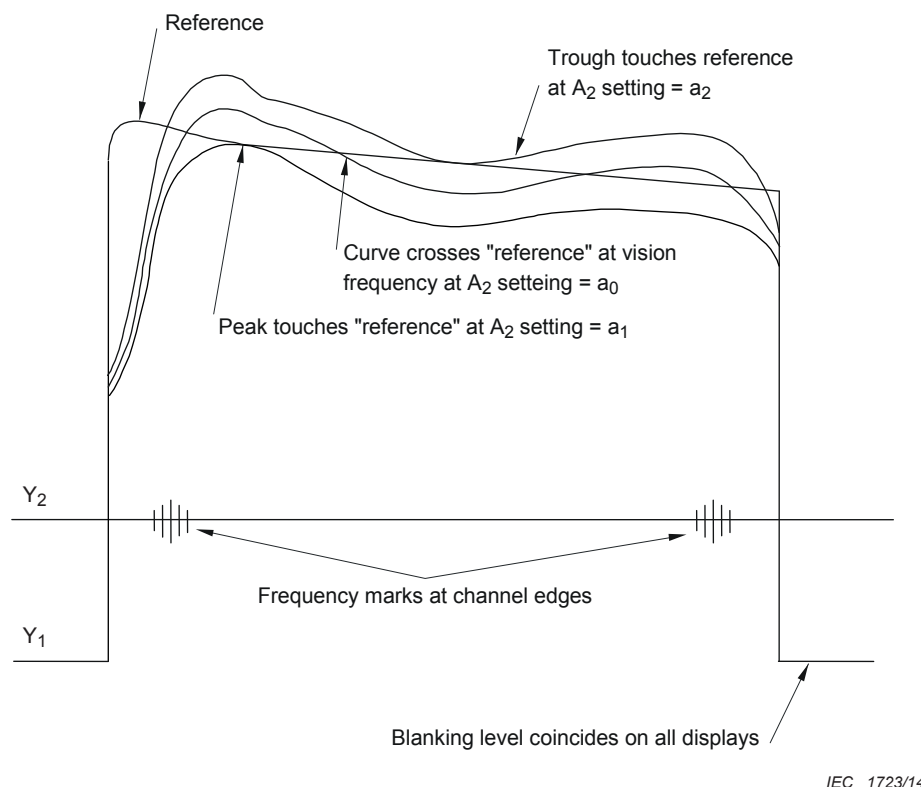


Figure 3 – Interpretation of displays for measurement of frequency response within a channel

- f) Adjust the attenuator A_2 to values 3 dB on either side of that set as specified in item b) of this subclause and check that the shape of the reference curve does not alter materially.
- g) Connect the equipment to the cable network as shown in Figure 2b removing the normal signal input to the channel under test, but retaining any pilot signals which may be necessary to maintain correct operation of the system.

NOTE 2 Signal-operated AGC systems may not function correctly on swept input signals and may have to be rendered inoperative and manual gain control used during these tests.

- h) Adjust the attenuator A_2 to produce the same general amplitude of display as obtained in item c) of this subclause, using the "reference" curve and carefully aligning the blanking level with that obtained in item e) of this subclause.
- i) Mark the frequency limits of the channel as described in item d) and item e) of this subclause.
- j) Using the attenuator A_2 , set up the display so that within the frequency limits marked in item i) of this subclause:
 - 1) the curve crosses the "reference" at the vision carrier frequency, interpolating if necessary; note the value a_0 , with correction for interpolation;
 - 2) the "peak" of the response touches the "reference", interpolating if necessary; note the value a_1 , with correction for interpolation.

The "trough" of the response touches the "reference", interpolating if necessary.

Note the value a_2 , with correction for interpolation.

- k) The variation of amplitude/frequency response within the channel is given by $(a_1 - a_0)$ and $(a_2 - a_0)$.

4.3.5 Presentation of the results

The results are presented in a table or by a curve showing the amplitude response within the measured channel.

4.4 Chrominance-luminance gain and delay inequalities

4.4.1 Overview

The methods described are only relevant for PAL and SECAM standards and applicable to the measurement of chrominance/luminance gain and delay inequalities for complete systems and constituent items of equipment. The test signals employed are in both cases those recommended in ITU-T Recommendation J.61, and are shown in Figure 4 and Figure 5.

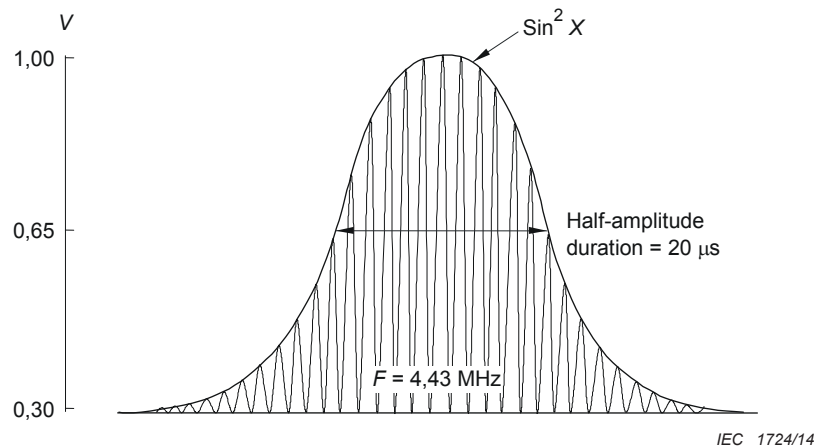
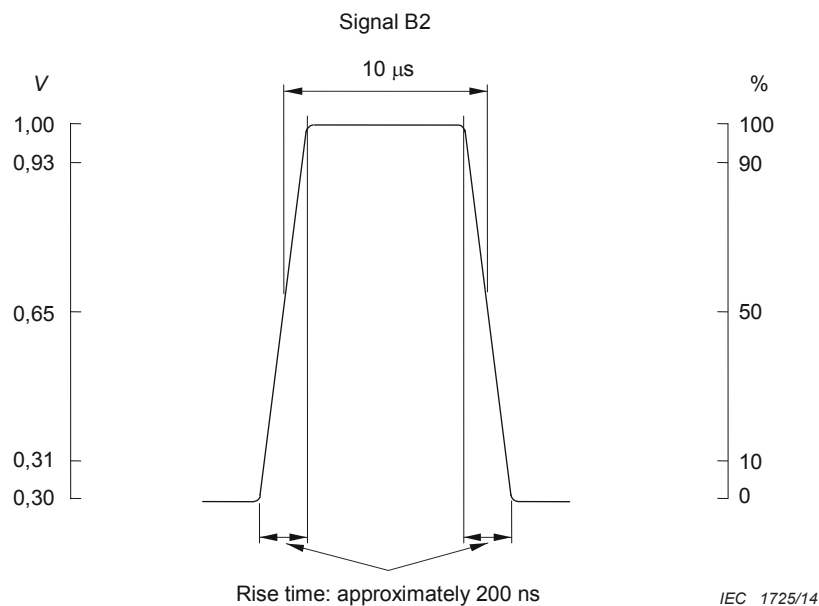


Figure 4 – Test signal (signal *F* for 625-line systems) employed for chrominance/luminance gain and delay inequality



NOTE In France, the nominal rise time B2 is approximately 110 ns.

Figure 5 – Test signal (signal *B2* for 625-line systems) employed for chrominance/luminance gain and delay inequality

It is intended that these measurements are carried out with test signals inserted at the system headend. They may be either of the full-frame type or, where convenient, may be inserted in the field blanking periods. The use of inserted test signals available on the broadcast television channel is not generally recommended as these are subject to variations beyond the control of the user. However, where such signals, of known stability and of adequate quality, are available, they may be used to carry out these measurements.

4.4.2 Equipment required

The test set-up shall be well-matched and shall consist of

- a) an oscilloscope which will not contribute significant distortion to the signal displayed,
- b) a modulator (unless transmitted test signals in the field blanking interval are to be used) having the following characteristics:
 - 1) radio-frequency characteristics (excluding sound) corresponding to ITU-R Recommendation BT.470, and appropriate to the television transmission system used;
 - 2) video signal input requirement of 1 V peak-to-peak composite;
 - 3) a modulated output signal of a convenient amplitude,
- c) a synchronous demodulator having characteristics appropriate to the television transmission system used,
- d) two attenuators variable in steps of not more than 1 dB,
- e) a test signal generator (unless transmitted test signals are used) providing signals having characteristics appropriate to the television transmission system under consideration, as specified in ITU-T Recommendation J.61 and containing composite pulse and bar signal elements B2 and F,

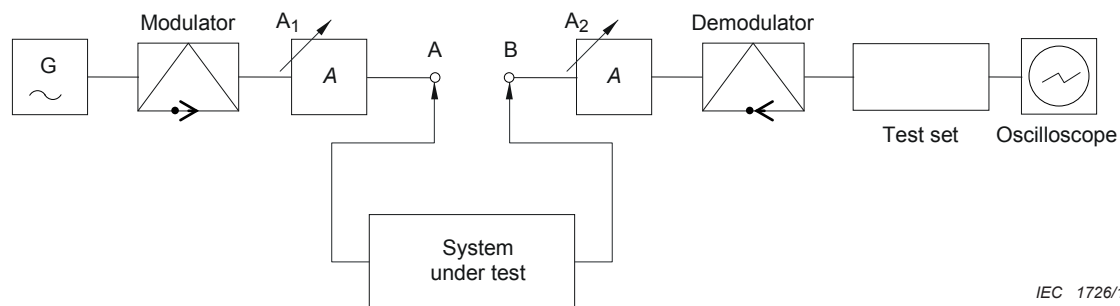
NOTE 1 Most commercially available test signal generators will provide this signal as part of a composite test line.

NOTE 2 For measurement on system I, a composite pulse of half-amplitude duration = 1 μ s would be an acceptable alternative to that shown as element F.

- f) a test set capable of providing calibrated variable delay and attenuation in either the chrominance or luminance areas of the video spectrum.

4.4.3 Connection of the equipment

The equipment shall be connected as in Figure 6.



IEC 1726/14

Figure 6 – Arrangement of test equipment for measurement of chrominance/luminance gain and delay inequality

4.4.4 Measurement procedure

The measurement procedure consists of the following steps.

- a) With point A directly connected to point B (see Figure 6), adjust attenuator A_1 for an output level sufficient to drive the system to be tested and attenuator A_2 to obtain the correct input level to the demodulator.
- b) Adjust the oscilloscope Y gain, Y shift and time base to obtain a suitable display of the composite pulse.

For convenience, the oscilloscope may be triggered so that the top of the bar is superimposed over the pulse, as in Figure 7.

Ensure that the distortion of the test signal due to the control loop (test equipment) is small compared with the limit specified for the system or equipment to be tested.

- c) Connect the system or equipment to be tested between points A and B.

Adjust the attenuator A_2 to return the input level to the demodulator to that given in item a) of this subclause.

- d) Using the oscilloscope controls, obtain a display as in item b) of this subclause.
- e) With the controls on the test set, null the delay inequality so that the bottom edge of the pulse is symmetrical about the vertical centreline of the pulse (see Figure 7b and Figure 8b).



Figure 7a – Before nulling delay

Figure 7b – After nulling delay

Figure 7 – Displayed pulses: chrominance low and lagging

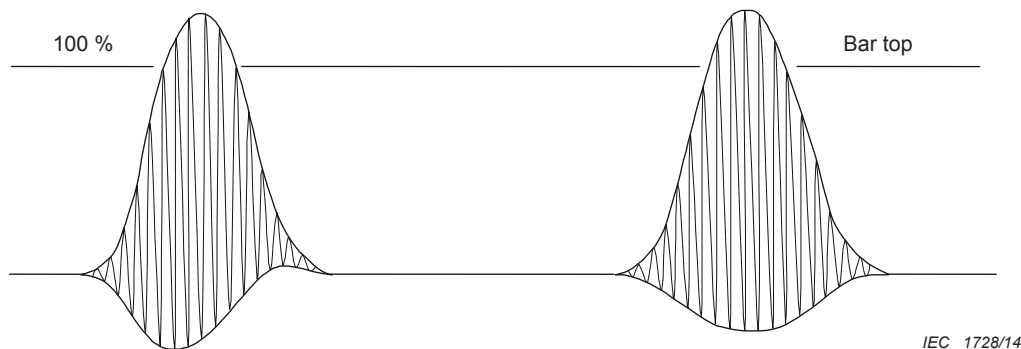


Figure 8a – Before nulling delay

Figure 8b – After nulling delay

Figure 8 – Displayed pulses: chrominance high and leading

- f) Using the calibrated attenuator on the test set, null the gain inequality so that the peak-to-peak amplitude of the chrominance signal equals that of the luminance bar.
- g) If necessary, repeat the procedure of 4.4.4 e) and 4.4.4 f).
- h) Read the gain and delay inequalities from the calibrated test set.

NOTE 1 If the measurement is carried out in the presence of echoes generated by discontinuities in the system under test, the result obtained will be subject to an error of magnitude not exceeding that of the echo.

NOTE 2 It is possible, without the use of the test set, to estimate the delay or gain inequality by direct observation of the pulse against a calibrated graticule and use of a suitable nomograph. The nomograph employed is that applicable to the half-amplitude duration of the particular composite pulse employed for the test. However, where non-linear distortion is present, particularly quadrature distortion in the demodulator, the results will be substantially erroneous.

4.4.5 Presentation of the results

The results are presented in a table showing the measured value of the chrominance-luminance gain and delay inequalities related to the measured channel.

4.5 Non-linear distortion

4.5.1 General

See IEC 60728-3. The methods described there are applicable to PAL and SECAM systems.

4.5.2 Intermodulation

See IEC 60728-3.

4.5.3 Composite beat

4.5.3.1 General

The method of measurement of composite beat using AM television signals is applicable to the measurement of the ratio of the carrier-to-composite beat at a specified point in a cable network. The method can also be used to determine the composite beat intermodulation performance of individual items of equipment. This measurement is carried out using the existing channels in the system with their normal modulation.

4.5.3.2 Overview

When the input signals are at regularly spaced intervals (as is common in most frequency allocations for TV channels), the various distortion products tend to cluster in groups, close to the vision carriers and at other regular positions within the TV channels. The number of different products in each cluster increases rapidly with the number of channels. They combine in different ways, depending on the degree of coherence between the generating signals, and the relative phases of the different distortion products.

The method described in this subclause measures the non-linear distortion of a device or system by the composite effect of all the beats clustered close to the vision carrier or at other positions within a TV channel. During the measurement, that channel has to be turned off. The composite beat measured is that generated by all carriers except that or those of the measured channel.

NOTE On systems carrying more than 10 channels, removal of the wanted channel does not significantly affect the result.

If the major contribution to the composite beat is due to distortion products of a particular order, the composite beat will follow the standard level variation for that order. If the composite beat, as measured, does not follow a standard level variation, it shall have significant contributions from distortion products of different orders.

The method is used to support a specification of the following general format: "the composite beat ratio for (list of carriers) in channel (A) at B dB(μ V) is C dB".

(A) designates the channel in which the test is carried out. If omitted, the specification is understood to be a minimum specification for measurements at all the channels specified by the list of carriers.

B is the reference level at which all carriers are set during the measurement, unless otherwise specified. If all carriers are not at the same level, the specification should clearly indicate the level of each carrier relative to the reference level, which is that of the highest carrier level.

C is the composite beat ratio, usually given as a minimum specification.

The list of carriers will usually be specified as a list of standard channel designations, signifying test signals at the frequencies of the corresponding vision carriers.

The ratio of carrier-to-composite beat may not vary with the output signal level in the way expected for distortion of a given order, and it may therefore be necessary to repeat the tests at levels higher and lower than those initially used. Repeat the tests at levels 2 dB higher and lower. It is recommended that these repeat tests are done on the channel which produced the lowest beat ratio during the test.

4.5.3.3 Equipment required

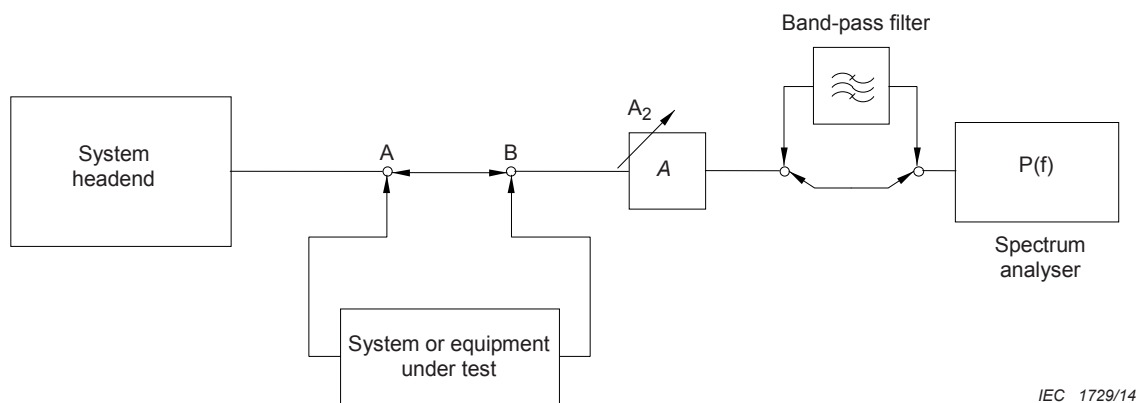
The measurement procedure consists of the following steps.

- A spectrum analyser with 30 kHz IF bandwidth and 10 Hz video bandwidth capability.
When using a spectrum analyser with minimum video filtering capabilities greater than 10 Hz, the composite third-order distortion may be noisy and should be read in the middle of the trace.
- A variable 75 Ω attenuator, adjustable in 1 dB steps.
- A bandpass filter for each channel to be tested or a tunable bandpass filter. This filter should attenuate the other channels present on the system to be tested sufficiently to ensure that the products generated by non-linearity in the spectrum analyser itself do not contribute significantly to the composite beat products to be measured. The passband of this filter shall at least be flat within 1 dB over the frequency range of interest.

NOTE If the linearity of the spectrum analyser is sufficient and known, this filter is not necessary.

4.5.3.4 Connection of the equipment

The equipment is connected as in Figure 9.



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Figure 9 – Connection of test equipment for the measurement of non-linear distortion by composite beat

4.5.3.5 Measurement procedure

The measurement procedure consists of the following steps:

- Connect point A directly to point B and disconnect the band pass filter (see Figure 9).
- Adjust the spectrum analyser as follows:

IF bandwidth:	30 kHz
Video bandwidth:	10 Hz
Scan width:	50 kHz/div
Vertical scale:	10 dB/div
Scan-time:	0,2 s/div