

Cable networks for television signals, sound signals and interactive services

Part 7: System performance

ICS 33.060.40

National foreword

This British Standard is the UK implementation of EN 50083-7:1996+A1:2000, incorporating corrigenda December 2005 and August 2007. It supersedes BS EN 50083-7:1997, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CENELEC text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment 1 is indicated by Ⓐ1 Ⓐ1.

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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 7: System performance

Réseaux de distribution par câbles pour signaux de
télévision, signaux de radiodiffusion sonore et
services interactifs
Partie 7: Caractéristiques des systèmes

Kabelnetze für Fernsehsignale, Tonsignale und
interaktive Dienste
Teil 7: Systemanforderungen

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CENELEC

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European standard was prepared by CENELEC Technical Committee TC 209, *Cabled distribution systems for television and sound signals*.

After having failed in the UAP, started in September 1993, a reworked draft was submitted to the formal vote and was approved by CENELEC as EN 50083-7 on 1995-11-28.

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) 1996-09-01
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Foreword to amendment A1

This amendment was prepared by the Technical Committee CENELEC TC 209, Cable networks for television signals, sound signals and interactive services.

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1 Scope

1.1 General

Standards of EN 50083 series deal with cable networks for television signals, sound signals and interactive services including equipment, systems and installations:

- for headend reception, processing and distribution of television and 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.

All kinds of networks like:

- CATV-networks;
- MATV-networks and SMATV-networks;
- Individual receiving networks;

and all kinds of equipment, systems and installations installed in such networks, are within this scope.

The extent of this standardization work is from the antennas, special signal source inputs to the headend or other interface points to the network up to the system outlet or the terminal input, where no system outlet exists.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals etc.) as well as of any coaxial and optical cables and accessories therefore is excluded.

1.2 Specific scope of this Part 7

This standard is applicable to any cable network having a coaxial cable output and primarily intended for television and sound signals operating between about 30 MHz and 2 150 MHz.

This standard lays down the basic methods of measurement of the operational characteristics of cable networks having coaxial cable outputs in order to assess the performance of those networks and their 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.

NOTE 1 Methods of measurement described in this standard are considered as basic. However, any equivalent method that ensures at least the same accuracy may be used.

NOTE 2 If the system operator wishes to subdivide the system into a number of parts, the accumulation of degradations should not exceed the figures given below.

NOTE 3 An extension of the frequency range to that from 5 MHz to 3 000 MHz will be considered for future work.

NOTE 4 System performance requirements of return paths as well as special methods of measurement for the use of the return paths in cable networks are described in EN 50083-10. 

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

Ⓐ ¹⁾ EN 50083		<i>Cable networks for television signals, sound signals and interactive services.</i>
EN 50083-2 + A1	1995 1997	<i>Part 2: Electromagnetic compatibility for equipment.</i>
EN 50083-3	1998	<i>Part 3: Active wideband equipment for coaxial cable networks.</i>
EN 50083-4	1998	<i>Part 4: Passive wideband equipment for coaxial cable networks.</i>
EN 50083-5	2000 ¹⁾	<i>Part 5: Headend equipment.</i>
EN 50083-6	1997	<i>Part 6: Optical equipment.</i>
EN 50083-10	1999	<i>Part 10: System performance for return paths.</i>
EN 60068/ HD 323 series		<i>Environmental testing/Basic environmental testing procedures.</i>
EN 300 421 V1.1.2	1997	<i>Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services.</i>
EN 300 429 V1.2.1	1998	<i>Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems.</i>
EN 300 473 V1.1.2	1997	<i>Digital Video Broadcasting (DVB); Satellite Master Antenna Television (SMATV) distribution systems.</i>
EN 300 744 V1.2.1	1999	<i>Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television.</i>
ETS 300 158 ed.1	1992	<i>Satellite Earth Stations (SES); Television Receive Only (TVRO) Satellite Earth Stations operating in the 11/12 GHz FSS bands.</i>
ETS 300 249 ed.1	1993	<i>Satellite Earth Stations (SES); Television Receive Only (TVRO) Satellite Earth Stations operating in the 12 GHz BSS band.</i>
ETS 300 457 ed. 1	1995	<i>Satellite earth stations and systems (SES); Test methods for Television Receive Only (TVRO) operating in the 11/12 GHz frequency bands.</i>
IEC 60050(60)	1970	<i>International Electrotechnical Vocabulary Chapter 60: Radiocommunications.</i>
CISPR 16-1	1993	<i>Specification for radio disturbance and immunity measuring apparatus and methods — Part 1: Radio disturbance and immunity measuring apparatus.</i>

¹⁾ To be published.

3 Terms, definitions, symbols and abbreviations

3.1

Terms and definitions

The terms defined here are those used later in the text and which are not defined in IEC 60050 (60). Ⓐ¹⁾

3.1.1

headend

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

NOTE The headend may, for example, comprise antenna amplifiers, frequency converters, combiners, separators and generators.

3.1.2

local headend

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

3.1.3

hub headend

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

3.1.4

remote headend

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

3.1.5

distribution point

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

NOTE In some cases a distribution point may be directly connected to the headend.

3.1.6

feeder

a transmission path forming part of a cabled distribution system.

such a path may consist of a metallic cable, optical fibre, waveguide, or any combination of them

by extension the term is also applied to paths containing one or more radio links

3.1.7

supertrunk feeder

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

3.1.8

trunk feeder

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

3.1.9

branch feeder

a feeder used for connecting a distribution point to spur feeders

3.1.10

spur feeder

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

3.1.11

subscriber feeder

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

NOTE A subscriber feeder may include filters and balun transformers.

3.1.12

antenna amplifier

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

3.1.13

trunk amplifier

an amplifier to compensate for the attenuation in a trunk feeder

3.1.14 bridger amplifier

3.1.14.1

an amplifier for connection in a trunk feeder to energize a distribution point

3.1.14.2

an amplifier for connection in a branch feeder, to energize one or more branch or spur feeders

3.1.15

trunk-bridger amplifier

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

3.1.16

distribution amplifier

an amplifier designed to feed one or more branch or spur feeders

NOTE This is a general term embracing branch amplifier and spur amplifier.

3.1.17

branch amplifier

an amplifier to compensate for the attenuation in a branch feeder

3.1.18

spur amplifier (line extender)

an amplifier to compensate for the attenuation in a spur feeder

3.1.19

automatic level controlled amplifier

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

NOTE 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.

3.1.20

frequency converter

a device for changing the carrier frequency of one or more signals

3.1.21

combiner

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

NOTE Some forms of this device may be used in the reverse direction as splitters.

3.1.22

separator

a 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 For example, a diplexer is a two-output separator.

NOTE 2 Some forms of this device may be used in the reverse direction for combining.

3.1.23

splitter (spur unit)

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

NOTE Some forms of this device may be used in the reverse direction for combining signal energy.

3.1.24

directional coupler

a splitter in which the attenuation between any two output ports exceeds the sum of the attenuations between the input port and each of those output ports

3.1.25

equalizer

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

3.1.26

subscriber tap

a device for connecting a subscriber feeder to a spur feeder

3.1.27

system outlet

a device for interconnecting a subscriber feeder and a receiver lead

3.1.28**looped system outlet**

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

3.1.29**receiver lead**

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

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

3.1.30**signal adaptor**

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

3.1.31**decibel ratio**

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

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

NOTE May also be expressed in terms of voltages

$$20 \lg \frac{V_1}{V_2} \text{ (dB)}$$

3.1.32**standard reference power P_0**

in cabled systems the standard reference power P_0 is 1/75 pW

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

3.1.33**level**

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

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

the level of any voltage V_1 is the decibel ratio of that voltage to the standard reference voltage V_0 , i.e.

$$20 \lg \frac{V_1}{V_0} \text{ dB}$$

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

3.1.34**attenuation**

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

3.1.35**gain**

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

3.1.36**automatic gain control (AGC)**

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

3.1.37**frequency amplitude response**

the gain or loss of an equipment or system plotted against frequency

3.1.38

slope

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

3.1.39

signal tilt

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

if groups of signals are established at differing levels, this is referred to as block tilt

3.1.40

crossview

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

3.1.41

crossmodulation

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

3.1.42

intermodulation

the 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

3.1.43

carrier to intermodulation ratio

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

3.1.44

carrier to noise ratio

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

3.1.45

mutual isolation

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

3.1.46

echo rating E for PAL and SECAM

the result of a system test with a $2T$ sine-squared pulse (as determined in CCIR Recommendations 473 [1] and 567 [2]) using the boundary line on a specified graticule (e.g. Figure 25) within which all parts of the received pulse fall

NOTE 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.

3.1.47

frequency designations

 the frequency designations and abbreviations of IEC Publication 60050(60) *International Electrotechnical Vocabulary (IEV), Chapter 60: Radio-communications (60-02-020)* shall be used in relation to cabled systems (e.g. a VHF system includes frequencies between 30 MHz and 300 MHz)

3.1.48

well-matched

the matching condition when the return loss of the equipment complies with the requirements of Table 1 of EN 50083-3

3.1.49**definitions for digital radio**

under consideration

3.1.50**definitions for return paths**

under consideration

3.1.51**definitions for satellite broadcasting**

[A1] see ETS 300 158, ETS 300 249 and ETS 300 457 respectively, under consideration [A1]

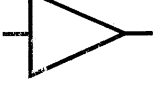
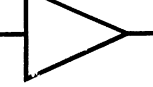
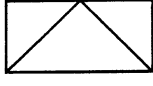
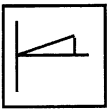
3.1.52**definitions for scrambled signals**

under consideration

3.1.53**definitions for teletext**

under consideration

3.2**[A1] Symbols**

Symbols	Terms	Symbols	Terms
	attenuator		variable attenuator
	sine-wave generator		low-pass filter
	band-pass filter		variable band-pass filter
	amplifier		RF amplifier
	oscilloscope		mixer
	modulator		demodulator
	RF-choke		resistor
	detector		

[A1]

3.3

Abbreviations

AC	Alternating Current
AGC	Automatic Gain Control
ALC	Automatic Level Control
AM	Amplitude Modulation
BW	Bandwidth
CCIR	Comité Consultatif International Radiodiffusion
CENELEC	Comité Européen de Normalisation Electrotechnique
COFDM	Coded Orthogonal Frequency Division Multiplex
CW	Continuous Wave
DAB	Digital Audio Broadcasting
DC	Direct Current
DSR	Digital Satellite Radio
DVB	Digital Video Broadcasting
DVB-C	Digital Video Broadcasting — Cable
DVB-S	Digital Video Broadcasting — Satellite
DVB-T	Digital Video Broadcasting — Terrestrial
EN	European Norm
ETS	European Telecommunication Standard
FDM	Frequency Division Multiplex
FM	Frequency Modulation
IF	Intermediate Frequency
ITS	Insertion Test Signal
NICAM	Near-Instantaneously Companded Audio Multiplex
PAL	Phase Alternation Line
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RMS	Root Mean Square
RSBW	Resolution Bandwidth
SECAM	Séquentiel Couleur A Mémoire
SHF	Super High Frequency
S/N	Signal-to-Noise (ratio)
TV	Television
TVRO	Television Receive Only
VSF	Vestigial Side Band

NOTE Only the abbreviations used in the English version of this part of EN 50083 are mentioned in this subclause. The German and the French versions of this part may use other abbreviations. Refer to 3.3 of each language versions for details. 

4 Methods of measurement

4.1 Mutual isolation between system outlets

General

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

- system outlets connected to adjacent subscribers' taps;
- system outlets connected to the same multiple subscribers' tap;
- adjacent looped system outlets.

4.1.1 *Equipment required*

The test set-up shall be well-matched.

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.

4.1.1.1 A sweep frequency generator, with frequency range or ranges to suit the system to be examined, equipped with a frequency marking system.

4.1.1.2 A terminating wideband detector.

4.1.1.3 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.

4.1.1.4 A wideband amplifier with sufficient gain to raise the signal level at the system outlet to a level suitable to drive the detector.

4.1.1.5 An oscilloscope or other display unit suitable for operation with the sweep frequency generator.

4.1.1.6 A suitable coaxial cable of sufficient length to reach from one system outlet to an adjacent one in the cabled distribution system.

4.1.2 *Connection of the equipment*

The equipment shall be connected as in Figure 1.

4.1.3 *Measurement procedure*

4.1.3.1 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 as α_1 .

4.1.3.2 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.

4.1.3.3 Adjust the oscilloscope and amplifier gain controls to produce a display and note the amplitude of the display over the frequency range under inspection.

4.1.3.4 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 4.1.1.6) is used to connect to the “remote” outlet.

4.1.3.5 Reduce the attenuator setting until the peak of the display just reaches the same amplitude as that noted in 4.1.3.3 for the frequency at which the peak occurs. Note the new value of the attenuator α_2 .

4.1.3.6 Mutual isolation is given by $\alpha_1 - \alpha_2$.

4.1.3.7 If the system outlets are of dual socket design, for example, TV – 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 .

4.1.3.8 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 *Amplitude response within a channel*

General

The method described is applicable to the measurement of the amplitude response of cabled distribution systems 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 4.2.3.1, 4.2.3.2, 4.2.3.3, 4.2.3.4, 4.2.3.5, 4.2.3.6 and 4.2.3.7) 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.

4.2.1 Equipment required

The test set-up shall be well-matched.

4.2.1.1 A sweep frequency generator.

4.2.1.2 A terminating RF detector.

4.2.1.3 Two variable attenuators.

4.2.1.4 An amplifier.

4.2.1.5 A dual-trace oscilloscope.

4.2.1.6 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.

4.2.1.7 A balanced mixer.

4.2.1.8 A low-pass filter with cut-off at approximately 200 kHz for television channels or approximately 10 kHz for FM sound radio.

4.2.1.9 A directional coupler suitable for use in the frequency range of the channel to be tested.

4.2.1.10 A termination to match the output of the filter specified in 4.2.1.8.

4.2.2 Connection of the equipment

The equipment shall be connected as in Figure 2a. If the tests are to 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 at the frequencies of the other signals to reduce them to about 20 dB below the level of the swept test signal.

4.2.3 Measurement procedure

4.2.3.1 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 A₁, so that the level of the signal at its output is that which will be required when connected to the system input.

4.2.3.2 Set the variable attenuator A₂, 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 made.

4.2.3.3 Adjust the oscilloscope controls to obtain a satisfactory display on the Y₁ channel, which shall be DC coupled, locking the timebase to the leading edge of the display.

NOTE 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.

4.2.3.4 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 Y₂ channel of the oscilloscope to produce a satisfactory "marker".

4.2.3.5 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.

4.2.3.6 Adjust the attenuator A₂ to values 3 dB either side of that set as specified in 4.2.3.2 and check that the shape of the reference curve does not alter materially.

4.2.3.7 Connect the equipment to the cabled distribution system 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 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.

4.2.3.8 Adjust the attenuator A_2 to produce the same general amplitude of display as obtained in 4.2.3.3, using the “reference” curve and carefully aligning the blanking level with that obtained in 4.2.3.5.

4.2.3.9 Mark the frequency limits of the channel as described in 4.2.3.4 and 4.2.3.5.

4.2.3.10 Using the attenuator A_2 , set up the display so that within the frequency limits marked in 4.2.3.9:

- a) the curve crosses the “reference” at the vision carrier frequency, interpolating if necessary; Note the value a_0 , with correction for interpolation;
- b) the “peak” of the response touches the “reference”, interpolating if necessary; Note the value a_1 , with correction for interpolation;
- c) the “trough” of the response touches the “reference”, interpolating if necessary. Note the value a_2 , with correction for interpolation.

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

4.3 Chrominance-luminance gain and delay inequalities

NOTE This is relevant only for PAL and SECAM standards.

General

The methods described are 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 CCIR Recommendation 567 [2], and are shown in Figure 4 and Figure 5.

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.

4.3.1 Equipment required

The test set-up shall be well matched.

4.3.1.1 An oscilloscope which will not contribute significant distortion to the signal displayed.

4.3.1.2 A modulator (unless transmitted test signals in the field blanking interval are to be used) having the following characteristics:

- a) radio-frequency characteristics (excluding sound) corresponding to CCIR Report 624 [3], and appropriate to the television transmission system used;
- b) video signal input requirement of 1 V peak-to-peak composite;
- c) a modulated output signal of a convenient amplitude.

4.3.1.3 A synchronous demodulator having characteristics appropriate to the television transmission system used.

4.3.1.4 Two attenuators variable in steps of not more than 1 dB.

4.3.1.5 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 CCIR Recommendation 567 [2], 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.

4.3.1.6 A test set capable of providing calibrated variable delay and attenuation in either the chrominance or luminance areas of the video spectrum.

4.3.2 Connection of the equipment

The equipment shall be connected as in Figure 6.

4.3.3 Measurement procedure

4.3.3.1 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.

4.3.3.2 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.

4.3.3.3 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 **4.3.3.1**.

4.3.3.4 Using the oscilloscope controls, obtain a display as in **4.3.3.2**.

4.3.3.5 With the controls on the test set, null the delay inequality so that the bottom edge of the pulse is symmetrical about the vertical centre line of the pulse (see Figure 7b and Figure 8b).

4.3.3.6 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.

4.3.3.7 If necessary, repeat the procedure of **4.3.3.5** and **4.3.3.6**.

4.3.3.8 Read the gain and delay inequalities from the calibrated test set.

NOTE 1 If the measurement is made 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 in error.

4.4 Non linear distortion

General

See EN 50083-3. The methods described there are applicable to PAL and SECAM systems.

4.4.1 Intermodulation

See EN 50083-3.

4.4.2 Composite beat

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 cabled distribution system. The method can also be used to determine the composite beat intermodulation performance of individual items of equipment. This measurement is made using the existing channels in the system with their normal modulation.

4.4.2.1 Introduction

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 clause 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 made. 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 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.

4.4.2.2 *Equipment required*

4.4.2.2.1 A spectrum analyser with 30 kHz IF bandwidth and 10 Hz video bandwidth capability.

NOTE 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 at the middle of the trace.

4.4.2.2.2 A variable 75 Ω attenuator, adjustable in 1 dB steps.

4.4.2.2.3 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.

4.4.2.3 *Connection of the equipment*

The equipment is connected as in Figure 11.

4.4.2.4 *Measurement procedure*

4.4.2.4.1 Connect point A directly to point B and disconnect the bandpass filter (see Figure 11).

4.4.2.4.2 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.

4.4.2.4.3 Tune the spectrum analyser to the channel in which the measurement is to be made so as to display the vision carrier in a frequency range of 0,5 MHz towards the sound carrier.

4.4.2.4.4 Adjust the sensitivity of the spectrum analyser together with its internal and external input attenuator in such a way that the response to the vision carrier corresponds to a full scale reference. At the same time the noise level shall be at least 60 dB, and preferably 65 dB, below the reference level.

4.4.2.4.5 Insert the bandpass filter (if necessary) corresponding to the channel to be measured and adjust the input attenuator to correct for the attenuation of the filter.

4.4.2.4.6 Disconnect the signal feed for the channel to be measured and terminate the input socket with its nominal impedance.

4.4.2.4.7 Verify that the intermodulation products generated in the spectrum analyser over the entire channel are below the reference level by an amount at least 20 dB greater than the required distortion distance. If this is not the case, disconnect the bandpass filter and repeat the steps **4.4.2.4.4**, **4.4.2.4.5**, **4.4.2.4.6** and **4.4.2.4.7** of this procedure with an increased input attenuation of the spectrum analyser.

4.4.2.4.8 Note the setting of the sensitivity control or the reference level control.

4.4.2.4.9 Reconnect the signal feed for the channel and repeat steps **4.4.2.4.3**, **4.4.2.4.4**, **4.4.2.4.5**, **4.4.2.4.6**, **4.4.2.4.7** and **4.4.2.4.8** of this procedure for all channels.

4.4.2.4.10 Connect the system to be tested between points A and B.

4.4.2.4.11 Adjust the centre frequency of the spectrum analyser as in **4.4.2.4.3** and insert the appropriate band-pass filter, if necessary.

4.4.2.4.12 Adjust the input attenuator (internal and/or external) to return the response of the spectrum analyser to the vision carrier to full scale with the appropriate setting of its sensitivity control (see **4.4.2.4.8**).

NOTE The external attenuator should be set to a minimum of 10 dB if the filter is in use, otherwise the system under test will see a serious mismatch.

4.4.2.4.13 Disconnect the signal feed for the channel to be measured and terminate the input socket with its nominal impedance.

4.4.2.4.14 Note the frequencies at which intermodulation products occur and the level of these products compared with the reference level in the frequency range displayed by the spectrum analyser.

4.4.2.4.15 Reconnect the signal feed for the channel, adjust the analyser tuning so as to display the next 0,5 MHz range.

4.4.2.4.16 Repeat steps **4.4.2.4.11**, **4.4.2.4.12**, **4.4.2.4.13**, **4.4.2.4.14** and **4.4.2.4.15** until the entire channel has been examined.

4.4.2.4.17 If the composite beats are clustered about the vision carrier then the signal/composite beat ratio is read directly off the screen of the spectrum analyser. In cases where there are several clusters, then the ratio is calculated and the subjective effect will be obtained by using the following formula which assumes power addition of the beats:

$$\text{Signal/composite beat} = -10 \lg \sum_{j=1}^M 10^{-((L_j + K_j)/10)}$$

where

- M is the number of different frequencies at which intermodulation products clusters occur.
- L_j corresponds to the ratio, expressed in decibels, of the reference level, at the relevant frequency, to that of the intermodulation product.
- K_j is the weighting factor expressed in decibels at the relevant frequency as obtained from Figure 9, Figure 10, Figure 12, Figure 13.

NOTE A cluster is a group of beats (intermodulation products) falling around a carrier or inside a TV channel.

4.4.2.4.18 Repeat the steps in **4.4.2.4.11**, **4.4.2.4.12**, **4.4.2.4.13**, **4.4.2.4.14**, **4.4.2.4.15** and **4.4.2.4.16** of this procedure for every channel used in this test.