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Kabelska omrežja za televizijske in zvokovne signale ter interaktivne storitve - 3. del: Aktivna širokopasovna oprema za koaksialna kabelska omrežja

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

Kabelnetze für Fernsehsignale, Tonsignale und interaktive Dienste -- Teil 3: Aktive Breitbandgeräte für koaxiale Kabelnetze

Réseaux de distribution par câbles pour signaux de télévision, signaux de radiodiffusion sonore et services interactifs -- Partie 3: Matériels actifs à large bande utilisés dans les réseaux de distribution coaxiale

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English version

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

Réseaux de distribution par câbles pour signaux de télévision, signaux de radiodiffusion sonore et services interactifs
Partie 3: Matériels actifs à large bande utilisés dans les réseaux de distribution coaxiale

Kabelnetze für Fernsehsignale, Tonsignale und interaktive Dienste
Teil 3: Aktive Breitbandgeräte für koaxiale Kabelnetze

This European Standard was approved by CENELEC on 2001-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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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 Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

This European Standard was prepared by CENELEC Technical Committee TC 209, "Cable networks for television signals, sound signals and interactive services" on the basis of EN 50083-3:1998 and the first amendment to EN 50083-3.

The text of this first amendment was submitted to the Unique Acceptance Procedure and was approved by CENELEC on 2001-10-01 to be published as part of a second edition of EN 50083-3.

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)	2002-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2004-10-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, Annexes A, B, C and D are normative and Annexes E and F are informative.

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

1.2 Specific scope of this part 3

This standard

- applies to all broadband amplifiers used in cable networks;
- covers the frequency range 5 MHz to 3000 MHz;
- applies to one-way and two-way equipment;
- lays down the basic methods of measurement of the operational characteristics of the active equipment in order to assess the performance of this equipment;
- identifies the performance specifications that shall be published by the manufacturers;
- states the minimum performance requirements of certain parameters.

Amplifiers are divided into the following two quality levels:

Grade 1: Amplifiers typically intended to be cascaded.

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

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

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

2 Normative references

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 revision 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.

EN 50083		Cable networks for television signals, sound signals and interactive services
EN 50083-1 + A1 + A2	1993 1997 1997	Part 1: Safety requirements
EN 50083-2	2001	Part 2: Electromagnetic compatibility for equipment
EN 50083-4	1998	Part 4: Passive wideband equipment for coaxial cable networks
EN 50083-5	2001	Part 5: Headend equipment
EN 50083-6	1997	Part 6: Optical equipment
EN 50083-10	2002	System performance for return paths
EN 60068 / HD 323	series	Environmental testing/Basic environmental testing procedures
EN 60169-24	1993	Radio frequency connectors – Part 24: Radio frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (Type F) (IEC 60169-24:1991)
EN 60417	series	Graphical symbols for use on equipment (IEC 60417 series)
EN 60529 + A1	1991 2000	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989 + A1:1999)
EN 61319-1 + A11	1996 1999	Interconnections of satellite receiving equipment Part 1: Europe (IEC 61319-1:1995)
EN 80416	series	Basic principles for graphical symbols for use on equipment (EIC 80416 series)
HD 134.2.S2	1984	Radio frequency connectors – Part 2: Coaxial unmatched connector (IEC 60169-2:1965 + A1:1982)
ES 200 800 V1.3.1	2001	Digital Video Broadcasting (DVB); DVB interaction channel for Cable TV distribution systems (CATV)
ETS 300 158	1992	Satellite Earth Stations and Systems (SES) - Television Receive Only (TVRO-FSS) Satellite Earth Stations operating in the 11/12 GHz FSS bands
ETS 300 249	1993	Satellite Earth Stations and Systems (SES) - Television Receive Only (TVRO) equipment used in the Broadcasting Satellite Service (BSS)

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purpose of this standard, the following definitions apply.

3.1.1
equaliser
a device designed to compensate over a certain frequency range for the amplitude/frequency distortion or phase/frequency distortion introduced by feeders or equipment

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

3.1.2
feeder
a transmission path forming part of a cable network. 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

3.1.3
decibel ratio
ten times the logarithm of the ratio of two quantities of power P_1 and P_2, i.e.

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

3.1.4
standard reference power and voltage
In cable networks the standard reference power, P_0, is 1/75 pW

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

The standard reference voltage, U_0, is 1μV

3.1.5
level
the level of any power P_1 is the decibel ratio of that power to the standard reference power P_0, i.e.

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

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

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

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

3.1.6
attenuation
ratio of the input power to the output power of an equipment or system, usually expressed in decibel

3.1.7
gain
decibel ratio of the output power to the input power

3.1.8
amplitude frequency response
gain or loss of an equipment or system plotted against frequency

3.1.9
slope
difference in gain or attenuation at two specified frequencies between any two points in an equipment or system

3.1.10
crossmodulation
undesired modulation of the carrier of a desired signal by the modulation of another signal as a result of equipment or system non-linearities

3.1.11
carrier to noise ratio
difference in decibel between the vision or sound carrier level at a given point in an equipment or system and the noise level at that point (measured within a bandwidth appropriate to the television or radio system in use)

3.1.12
noise factor/noise figure
noise factor/noise figure are used as figures of merit describing the internally generated noise of an active device

The noise factor (F) is the ratio of the carrier to noise ratio at the input, to the carrier to noise ratio at the output of an active device, assuming the incoming carrier is noise free.

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

where C_1 = signal power at the input

C_2 = singal power at the output

N_1 = noise power at the input (ideal thermal noise)

N_2 = noise power at the output

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

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

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

$$NF = 10 \lg F \text{ (dB)}$$

3.1.13
ideal thermal noise
noise generated in a resistive component due to the thermal agitation of electrons

The thermal power generated is given by:

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

where

P	=	noise power in watts		
B	=	bandwidth in hertz		
k	=	Boltzmann's constant	=	$1{,}38 \times 10^{-23}$ J/K
T	=	absolute temperature in kelvins		

It follows that:

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

and

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

where: U = noise voltage
R = resistance in ohms

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

3.1.14
chrominance / luminance delay inequality
delay inequality in nanoseconds, between the luminance and chrominance (4,43 MHz) within a single PAL/SECAM television channel. The worst case channels shall be identified by frequency.

3.1.15
well-matched
matching condition when the return loss of the equipment complies with the requirements of Table 1.

NOTE Through mismatching of measurement instruments and the measurement object measurement errors are possible. Comments to the estimation of such errors are given in Annex E.

3.1.16
multiswitch
equipment used in distribution systems for signals that are received from satellites and converted to a suitable IF. The IF signals that are received from different polarisations, frequency bands and orbital positions are input signals to the multiswitch. Subscriber feeders are connected to multiswitch output ports. Each output port is switched to one of the input ports, depending on control signals that are transmitted from the subscriber equipment to the multiswitch. Beside a splitter for each input port and a switch for each output port a multiswitch can contain amplifiers to compensate for distribution or cable losses.

3.1.17
multiswitch loop through port
one or more ports to loop through the input signals through a multiswitch. This enables larger networks with multiple multiswitches, each one installed close to a group of subscribers. The multiswitches are connected in a loop through manner. The IF signals that are received by an outdoor unit from different polarisations, frequency bands and orbital positions are input signals to a first multiswitch. Cables connect the loop through ports of this multiswitch to the input ports of a second multiswitch and so on.

3.1.18
multiswitch port for terrestrial signals
A network can be used to distribute terrestrial signals in addition to the signals received from satellites. The terrestrial antennas are connected to an optional terrestrial input port of a multiswitch. On each output port the terrestrial signals are available in addition to the satellite IF signals. Since the usual frequency ranges for terrestrial signals and satellite IF signals do not overlap, both can be carried on the same cable.

For large networks with loop through connected multiswitches, two possibilities exist to carry the terrestrial signals from one multiswitch to another multiswitch:

a) To use a specialised cable for the terrestrial signal, in addition with the cables used for the satellite IF signals and then, on each output port the terrestrial signal is combined with the selected satellite IF signal.

b) To combine the terrestrial signal with each satellite IF signal before the first multiswitch in order to minimise the number of cables between multiswitches.

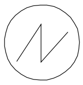
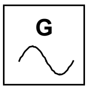
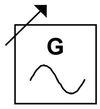
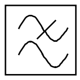
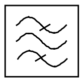
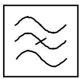
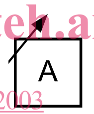
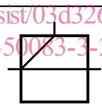
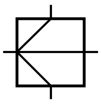
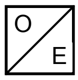
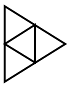
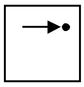
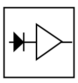
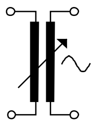
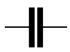
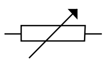
NOTE The signal coming from an outdoor unit for satellite reception may contain unwanted signal-components with frequencies below the foreseen satellite IF frequency range. These signal-components overlap with the frequency range of terrestrial signals. For example, an outdoor unit that converts the frequency band 11,7 to 12,75 GHz to the satellite IF frequency range may convert signals in the 10,7 to 11,7 GHz band to frequencies below the satellite IF frequency range. These frequencies have to be filtered out sufficiently to avoid interference with terrestrial signals on the same cable.

3.1.19
cross talk attenuation
unwanted signals beside the wanted signal on a lead caused by electromagnetic coupling between leads. Cross talk attenuation is the ratio of the wanted signal power to the unwanted signal power, while equal signal powers are applied to the leads. Cross talk attenuation is usually expressed in decibel.

3.1.20
composite intermodulation noise (CIN)
sum of noise and intermodulation products from digital modulated signals

3.1.21
composite intermodulation noise ratio (CINR)
ratio of the signal level and the CIN level.

3.2 Symbols

Symbols	Terms		Symbols	Terms
A	amperemeter		V	voltmeter
W	power meter			oscilloscope
	signal generator			variable signal generator
G kT	noise generator			low pass filter
	high pass filter			bandpass filter
	stop band filter		DUT	device under Test
A x dB	attenuator			variable attenuator
Σ	combiner			tap-off-box
	double tap-off-box			optical receiver
	amplifier with return path amplifier			spectrum analyser
	detector with LF-amplifier			adjustable AC voltage source
	ground			capacitor
	RF choke			variable resistor

3.3 Abbreviations

AC	alternating current
AF	audio frequency
AGC	automatic gain control
AM	amplitude modulation
CATV	community antenna television (system)
CIN	Composite intermodulation noise
CINR	Composite intermodulation noise ratio
CSO	composite second order
CTB	composite tripple beat
CW	continous wave
DUT	device under test
EMC	electromagnetic compatibility
HP	high pass
IF	intermediate frequency
IP	international protection
LF	low frequency
LP	low pass
MATV	master antenna television (system)
MTBF	meantime between failure
OMI	Optimum Modulation Index
PAL	phase alternating line
RF	radio frequency
RMS	root mean square
RS	rotary switch
SECAM	séquenciel couleur a mémoire
SG	signal generator
SMATV	satellite master antenna television (system)
TV	television
VSWR	voltage standing wave ratio
XMOD	cross modulation

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 version for details.

4 Methods of measurement

This clause defines basic methods of measurement. Any equivalent method that ensures the same accuracy may be used for assessing performance.

Unless stated otherwise, all measurements shall be carried out with 0 dB plug-in attenuators and equalisers. The position of variable controls used during the measurements shall be published.

The test set-up shall be well matched over the specified frequency band.

For measurements on multiswitches it is necessary that control signals be fed to the output ports that are involved in the measurement. Therefore, a bias-tee has to be connected between the multiswitch output port and the measurement set. The DC port of the bias-tee is connected to a standard receiver that generates the required control signals. Care has to be taken that the influence of the bias-tee on the measurement result is insignificant. This can be achieved by including it into the calibration or using a network analyser with a built in bias-tee.

4.1 Linear distortion

4.1.1 Return loss

The method described is applicable to the measurement of the return loss of equipment operating in the frequency range 5 MHz to 3 000 MHz.

All input and output ports of the unit shall meet the specification under all conditions of automatic and manual gain controls and with any combination of plug-in equalisers and attenuators fitted.

4.1.1.1 Equipment required

a) A signal generator or sweep generator, adjustable over the frequency range of the equipment to be tested;

   Care must be taken to ensure that the signal generator or sweep generator output does not have a high harmonic content as this can cause serious inaccuracy.

b) A voltage standing wave ratio bridge with built-in or separate RF detector;

   The accuracy of measurement is dependent on the quality of the bridge; in particular on the directivity and on the return loss of the test port of the bridge. For example Figure 2 shows the maximum accuracy achieved by a bridge with 46 dB directivity and 26 dB return loss.

c) An oscilloscope;

d) Calibrated mismatches;

4.1.1.2 Connection of equipment

The equipment shall be connected as in Figure 1.

4.1.1.3 Measurement procedure

NOTE 1 All coaxial input and output ports, other than those under test, shall be terminated in 75 Ω.

NOTE 2 Ensure that there is no supply voltage on the port being measured as this could damage the bridge. If it is necessary to use a voltage blocking device, use one with a good return loss (10 dB above requirement).

NOTE 3 Only good quality calibrated connectors, adaptors and cables shall be used.

The measurement procedure comprises the following steps:

a) Connect the equipment as shown in Figure 1;

b) Set the signal generator output level such that the device under test is not overloaded;

c) Use calibrated mismatches to calibrate the display on the oscilloscope;

d) Connect the device under test as shown in Figure 1 and check the return loss over the specified frequency range;