SIST

SLOVENSKI STANDARD
SIST EN 50083-3:1995

01-marec-1995

Kabelski distribucijski sistemi za televizijsko in zvokovno radiofuzijo - 3. del: Aktivna koaksialna širokopasovna distribucijska oprema

Cabled distribution systems for television and sound signals -- Part 3: Active coaxial wideband distribution equipment

Kabelverteilsysteme für Ton- und Fernsehrundfunk-Signale -- Teil 3: Aktive Breitbandgeräte für koaxiale Verteilnetze

Systèmes de distribution par câble destinés aux signaux de radiodiffusion sonore et de télévision -- Partie 3: Matériels actifs utilisés dans les systèmes de distribution coaxiale à large bande

Ta slovenski standard je istoveten z: EN 50083-3:1994

ICS:

33.060.40	Kabelski razdelilni sistemi	Cabled distribution systems
33.120.10	Koaksialni kabli. Valovodi	Coaxial cables. Waveguides

SIST EN 50083-3:1995 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50083-3

May 1994

UDC 621.397.743

Descriptors: Telecasting, cable television, sound broadcasting, television broadcasting, community aerial systems, coaxial cables, components, measuring techniques, specifications

English version

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Kabelverteilsysteme für Ton- und Fernsehrundfunk-Signale Teil 3: Aktive Breitbandgeräte für koaxiale Verteilnetze

This European Standard was approved by CENELEC on 22 September 1993. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in 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.

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CENELEC

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

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Ref. No. EN 50083-3:1994 E

Foreword

This European Standard was prepared by CENELEC Technical Committee TC 109, Cabled distribution systems for television and sound signals. The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50083-3 on 1993-09-22.

The following dates were fixed :

- latest date of publication of an identical national standard	(dop)	1994-12-01
- latest date of withdrawal of conflicting national standards	(dow)	1994-12-01

For products which have complied with the relevant national standard before 1994-12-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-12-01.

Annexes designated "normative" are part of the body of the standard. In this standard, all annexes are normative.

Contents

1 Scope

This standard

- applies to all broadband amplifiers used in cabled distribution systems;
- covers the frequency range 5 MHz to 1 750 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 Terms and definitions

For the purpose of this standard the following definitions apply.

2.1 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 distortion only.

2.2 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.

2.3 decibel ratio

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

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

2.4 standard reference power and voltage

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 r.m.s. across it.

The standard reference voltage, U_0, is 1 µV.

2.5 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 1 µV in 75 Ω) or more simply in dB(µV) if there is no risk of ambiguity.

2.6 attenuation

The ratio of the input power to the output power of an equipment or a system, usually expressed in decibel.

2.7 **gain**

The decibel ratio of the output power to the input power.

2.8 **amplitude frequency response**

The gain or loss of an equipment or system plotted against frequency.

2.9 **slope**

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

2.10 **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.

2.11 **carrier to noise ratio**

The 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).

2.12 **noise factor/noise figure**

The 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 = signal 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

$$NF = 10 \lg F \quad (dB)$$

2.13 **ideal thermal noise**

The 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 x 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 $U/2$.

2.14 **chrominance/luminance delay inequality**

The 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.

2.15 **well-matched**

The matching condition when the error introduced by the mismatch of the equipment connected to the DUT and that of the device under test (DUT) is acceptable. To calculate the maximum error, use the following formula:

$$\text{max measurement error in the return loss} = -20 \cdot lg \left| 1 \pm 10^{\frac{a_r - a_m}{20}} \right|$$

NOTE: The worst case condition occurs when the return loss of the DUT and of the test equipment are equal but have opposite phase, i.e., resonance occurs.

Ripple due to mismatch.

$$a_{ripple}\max \approx 40 \cdot lg \left(\frac{\left(1 + 10^{-\frac{a_m + a_r}{20}}\right)}{\left(1 - 10^{-\frac{a_m + a_r}{20}}\right)} \right) + 20 \cdot lg \left(\frac{\left(1 + 10^{-\frac{a_m}{20}}\right)}{\left(1 - 10^{-\frac{a_m}{20}}\right)} \right)$$

The first term describes the ripple due to the mismatch of the DUT at input and output, the second term gives the ripple due to mismatch between source and load with reference to Z_0. For simplicity this formula assumes that the test object has the same return loss value, a_r, at the input and the output. It is also assumed that the test units connected to the input and the output have the same return loss value, a_m.

a_r = DUT return loss in dB
a_m = return loss of test equipment in dB

General information:

The return loss of the test equipment should be at least 10 dB better than the expected DUT value.

3 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.

3.1 Linear distortion

3.1.1 Return loss

The method described is applicable to the measurement of the return loss of equipment operating in the frequency range 5 MHz to 1 750 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.

3.1.1.1 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.

3.1.1.2 Connection of equipment.

The equipment shall be connected as in figure 1.

3.1.1.3 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.

3.1.2 Flatness

Methods of measurement are well known and a full description of the procedure is not necessary.

Measurement is commonly made with a 75 Ω scaler or vector network analyser. Care must be taken that all equipment used (connectors, adaptors, cable etc.) are well matched.

3.1.3 Chrominance/luminance delay inequality for PAL/SECAM only.

The well known 20T pulse method of measurement is used. This is described in subclause 3.9 of EN 50083-5.

3.2 Non-linear distortion

3.2.1 General

3.2.1.1 Fundamentals

In a non-linear device, the expression for the output signal will, in general, have an infinity of terms, each generated from one or more of the (assumed sinusoidal) terms in the input, and particularly by the interaction of two or more terms. The transfer function of the device can be expressed as:

$$V_{out} = a_0 + a_1 V_{in} + a_2 V_{in}^2 + a_3 V_{in}^3 + \ldots\ldots a_n V_{in}^n + \ldots\ldots \text{etc.}$$

If the input signal V_{in} has m sinusoidal terms, then this can be expressed as:

$$V_{in} = V_1 \sin(\omega_1 t + \Phi_1) + V_2 \sin(\omega_2 t + \Phi_2) + \ldots\ldots V_m \sin(\omega_m t + \Phi_m)$$

The output signal is then a series of terms each of which can be expressed in the general form:

$CV_i a_n \sin(\omega_i t + \Phi_i)$, where:

ω_i is the sum or difference of integral positive multiples of one or more of the input frequencies, for example:

$4\omega_2$, $2\omega_1 - \omega_3$, $4\omega_1 + \omega_2$, $2\omega_1 + \omega_2 + \omega_3$.

This may be written in a general form as:

$$\omega_i = p_1 \omega_1 \pm p_2 \omega_2 \pm p_3 \omega_3 \pm \ldots\ldots p_m \omega_m$$

where:

ω_i = angular velocity $2\pi f_i$;

p_1 , p_2 , ...p_m are positive integers (including 0);

Φ_i is the relative phase of the output signals;

a_n is a coefficient of the transfer function;

V_i is a term dependent on the product of powers of the amplitudes of the input signals (V_1, V_2, etc.) where the sum of the powers equals n;

C is a numerical multiplier.

It should be noted that terms at the same frequency may arise from several different terms in the transfer function, i.e. for several different values of n.

Each component of the output signal represented by such an expression with n >1 is a non-linear distortion product, where ω_i is an integral multiple of a single term in the input signal, e.g. $4\omega_2$, the product is regarded as a harmonic distortion product. If it is formed from two or more terms, e.g. $2\omega_1 - \omega_3$, it is known as an intermodulation distortion product.

Since the values of a_1, a_2, a_3, etc., usually decrease relatively rapidly with increasing values of n, it is found that the predominant non-linear output signals arise from the terms in the transfer function in such a way that the sum $p_1 + p_2 + \ldots p_m = n$, and n is defined as the order of the non-linear distortion product, e.g. $3\omega_1 - 2\omega_3$ is a fifth order product arising from the term $a_5 V_{in}^5$.