SLOVENSKI STANDARD

SIST HD 560.1 S1:1999

01-julij-1999

Methods of measurement on radio receivers for various classes of emission - Part 1: General considerations and methods of measurement, including audio-frequency measurements (IEC 60315-1:1988)

Methods of measurement on radio receivers for various classes of emission -- Part 1: General considerations and methods of measurement, including audio-frequency measurements

Meßverfahren für Funkempfänger für verschiedene Sendearten -- Teil 1: Allgemeine Bedingungen und Meßverfahren einschließlich Tonfrequenz-Meßverfahren

Méthodes de mesure applicables aux récepteurs radioélectriques pour diverses classes d'émission -- Partie 1: Considérations générales et méthodes de mesure, y compris mesures aux fréquences audioélectriques

Ta slovenski standard je istoveten z: **HD 560.1 S1:1990**

ICS:

33.160.20 Radijski sprejemniki Radio receivers

SIST HD 560.1 S1:1999 **en**

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HD 560.1 S1

July 1990

ENGLISH VERSION

UDC: 621.396.62:621.317

Descriptors: Radio equipment, receiver, method of measurement, electrical characteristics

METHODS OF MEASUREMENT ON RADIO RECEIVERS FOR VARIOUS CLASSES OF EMISSION PART 1: GENERAL CONSIDERATIONS AND METHODS OF MEASUREMENT, INCLUDING AUDIO-FREQUENCY MEASUREMENTS

Méthodes de mesure applicables aux récepteurs radioélectriques pour diverses classes d'émission Première partie: Considérations générales et méthodes de mesure, y compris mesures aux fréquences audioélectriques

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BODY OF THE HD

The Harmonization Document consists of:

- IEC 315-1 (1988) ed 2; IEC/SC 12A, not appended

This Harmonization Document was approved by CENELEC on 1990-05-01.

The English and French versions of this Harmonization Document are provided by the text of the IEC publication and the German version is the official translation of the IEC text.

According to the CENELEC Internal Regulations the CENELEC member National Committees are bound:

to announce the existence of this Harmonization Document at national level by or before 1990-12-15

to publish their new harmonized national standard by or before 1991-06-15

to withdraw all conflicting national standards by or before 1991-06-15.

Harmonized national standards are listed on the HD information sheet, which is available from the CENELEC National Committees or from the CENELEC Central Secretariat.

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NORME INTERNATIONALE
INTERNATIONAL STANDARD

CEI
IEC
315-1

Deuxième édition
Second edition
1988

Méthodes de mesure applicables aux récepteurs radioélectriques pour diverses classes d'émission

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General considerations and methods of measurement, including audio-frequency measurements

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE X

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

METHODS OF MEASUREMENT ON RADIO RECEIVERS FOR VARIOUS CLASSES OF EMISSION

Part 1: General considerations and methods of measurement, including audio-frequency measurements

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by IEC Sub-Committee 12A: Receiving equipment, of IEC Technical Committee No. 12: Radiocommunications.

This second edition replaces the first edition of IEC Publication 315-1 (1970), its first supplement (Publication 315-1A (1971)) and IEC Publication 315-2 (1971).

The text of this standard is based upon the following documents:

Six Months' Rule	Report on Voting
12A(CO)119	12A(CO)126

Full information on the voting for the approval of this standard can be found in the Voting Report indicated in the above table.

The following IEC publications are quoted in this standard:

Publications Nos.
- 27: Letter symbols to be used in electrical technology.
- 50 (151) (1978): International Electrotechnical Vocabulary (IEV), Chapter 151: Electrical and magnetic devices.
- 65 (1985): Safety requirements for mains operated electronic and related apparatus for household and similar general use.
- 68: Environmental testing.
- 86: Primary batteries.
- 94: Magnetic tape sound recording and reproducing systems.
- 98 (1987): Analogue audio disk records and reproducing equipment.
- 225 (1966): Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations.
- 263 (1982): Scales and sizes for plotting frequency characteristics and polar diagrams.
- 268: Sound system equipment.

268-3 (1969): Part 3: Sound system amplifiers.
268-15 (1987): Part 15: Preferred matching values for the interconnection of sound system components.
417 (1973): Graphical symbols for use on equipment. Index, survey and compilation of the single sheets.
617: Graphical symbols for diagrams.
651 (1979): Sound level meters.
C.I.S.P.R. 13 (1975): Limits and methods of measurement of radio interference characteristics of sound and television receivers.

Other publications quoted:

ISO Standard 266-1975: Acoustics — Preferred frequencies for measurements.
CCIR Recommendation 468-4: Measurement of audio-frequency noise voltage level in sound broadcasting.

METHODS OF MEASUREMENT ON RADIO RECEIVERS FOR VARIOUS CLASSES OF EMISSION

Part 1: General considerations and methods of measurement, including audio-frequency measurements

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SECTION ONE — GENERAL

1. Scope

This standard applies to radio receivers of any kind, excluding television receivers, and to the parts of which they are composed or which are used as auxiliaries to such receivers, excluding those dealt with in IEC Publications 94, 98 and 268.

This standard deals with the determination of performance, the comparison of equipment and the determination of proper practical applications by listing the characteristics which are useful for specifications and laying down uniform methods of measurement for these characteristics.

This standard is confined to a description of the different characteristics and the relevant methods of measurement; it does not in general specify performance requirements.

The complete standard consists of the following parts, in which the characteristics of various types of receiver and their methods of measurement are specified; some parts include preferred values:

- Part 1: General considerations and methods of measurement, including audio-frequency measurements (IEC Publication 315-1 (1988)).
- Part 3: Radio-frequency measurements on receivers for amplitude-modulated emissions (Publication 315-3 (1973)).
- Part 4: Radio-frequency measurements on receivers for frequency modulated sound-broadcasting emissions (Publication 315-4 (1982)).
- Part 5: Specialized radio-frequency measurements. Measurements on frequency-modulated receivers of the response to impulsive interference (Publication 315-5 (1971)).
- Part 8: Radio-frequency measurements on professional receivers for frequency-modulated telegraphy systems (Publication 315-8 (1975)).

The standard does not deal with safety, for which reference is required to IEC Publication 65 or other appropriate IEC safety standards, nor with radiation and immunity, for which reference is required to C.I.S.P.R. Publication 13.

2. Units and system of measurement

The International System of Units (SI-units) as indicated in IEC Publication 27 is used exclusively in this standard.

3. Frequencies of measurement

3.1 *Audio-frequencies*

If measurements are to be made at discrete frequencies, then these shall be the frequencies specified as preferred frequencies for acoustical measurements in ISO Standard 266, reproduced in

Table I of this part. If a measurement relates to a reference audio-frequency, then, in the absence of a clear reason to the contrary, this shall be the standard reference frequency of 1 000 Hz.

If a measurement is to be made using only one signal frequency, the signal frequency shall be the chosen reference frequency. If measurements are to be made at a number of different frequencies, the chosen reference frequency shall be included, the other frequencies being so chosen that the results of the measurements give an adequate representation of the behaviour of the characteristics over the whole of the effective frequency range.

If measurements are to be made in frequency bands of constant relative bandwidth, preference shall be given to the one octave and one-third octave bands mentioned in Sub-clause 6.1.

3.2 *Radio-frequencies*

3.2.1 *General*

Where applicable, frequencies shall be chosen which are decimal multiples of those given in Table I. For some purposes it is necessary to use other frequencies, such as the intermediate frequency of the receiver, and frequencies at which spurious responses or other phenomena occur.

3.2.2 *Measurements on receivers with restricted tuning range*

Measurements at, or near, the extremes of the tuning range together with one or more frequencies in the middle of the range are normally adequate.

Further information is given in Clause 17 and Parts 3 and 4 of this standard.

4. Quantities to be specified and their accuracy

Unless otherwise stated, the terms "voltage", "current", etc, when used in this standard, refer to r.m.s. quantities. For most purposes it is sufficient to measure electrical quantities with an accuracy of ±0.15 dB. The accuracy of measurement required depends only on the purpose for which the results are to be used.

5. Marking and symbols for marking

5.1 *Marking*

Terminals and controls shall be adequately marked to give information regarding their function, characteristics and polarity.

The marking shall be such that it is possible to adjust the controls and to identify their positions with sufficient accuracy in connection with the information given in the user instructions.

5.2 *Symbols for marking*

Marking should preferably be composed of letter symbols, signs, numbers and colours, which are internationally intelligible. Reference should be made to IEC Publications 27, 617 and 417.

Markings not included in the above-mentioned standards shall be clearly explained in the user instructions.

6. Filters, weighting curves and meters for noise specification and measurement

A specification of noise or signal-to-noise ratio shall refer to noise measured by one of the following methods:

6.1 *Wide band measurement*

The filter shall be a band-pass filter having a frequency response within the limits shown in Figure 1. (This is identical to the wide-band filter specification in CCIR Recommendation 468-4). A band-pass filter which has a substantially constant transmission factor between 22.4 Hz and 22.4 kHz, decreasing outside this frequency band at the rates specified for octave band filters having mid-band frequencies of 31.5 Hz and 16 000 Hz specified in IEC Publication 225, has a response falling within the limits of this specification.

Note. — Care should be taken when there may be strong signals just above or below the band-limits since in this case the results will depend, to some degree, on the individual frequency response of the filter actually used.

6.2 *Weighted measurements*

6.2.1 *Noise (A-weighting) or signal-to-noise (A-weighting) ratio*

The filter used shall have A-weighting characteristics with type I tolerances as specified for sound level measurements in IEC Publication 651. The meter shall be a true r.m.s. meter as described in Publication 651 for sound level meters type I; the dynamic characteristics designated "S" shall be used.

Note. — A-weighted measurements are particularly appropriate where the noise output from the equipment in the absence of a programme is concerned.

6.2.2 *Noise (psophometric) or signal-to-noise (psophometric) ratio*

The filter and meter used shall have the characteristics described in Appendix A, which are identical to those specified in CCIR Recommendation 468-4.

Notes 1. — The word "psophometric" may be abbreviated to "ps" (see CCITT Recommendation J.16), if this causes no confusion.

2. — Psophometric measurements are particularly appropriate where the disturbing effect of the noise output from the system in the presence of a programme is concerned.

6.2.3 *Octave/third-octave band measurements*

The filters shall have characteristics as specified for octave or third-octave band filters in IEC Publication 225. The meter shall be a true r.m.s. meter as described in IEC Publication 651 for sound level meters, type I. When measuring in narrow bands, particularly at low frequencies, it is recommended that the instruments should conform dynamically to the characteristics designated "S" for the sound level meter.

7. **Rated values** (see IEV 151-04-03) [IEC Publication 50 (151)]

In this standard, the word "rated" is used in a particular sense. Wherever it is used it means "the value stated by the manufacturer". It always has this meaning even though it is used in two different kinds of technical terms, which are known as "rated conditions" and "rated values of characteristics" respectively.

7.1 *Rated conditions*

When an equipment is to be used or tested, it has to be operated under certain conditions which are fixed by the manufacturer. These conditions include electrical, mechanical and climatic conditions, and they cannot, by their nature, be verified by measurement.

Rated conditions for a particular type of equipment generally include some or all of the following:

— *Electrical*
- rated power supply voltage(s)
- rated power supply frequency
- rated source impedance(s)
- rated source e.m.f.(s)
- rated load impedance(s)

— *Mechanical*
- mounting position
- ventilation

— *Climatic*
- rated ambient temperature ranges for operation, and for full performance to specification
- rated humidity range
- rated air pressure range.

Note. — Ranges are defined by the extreme values, each of which may be regarded as a separate rated condition.

7.2 *Rated value of a characteristic*

In IEC Publication 315, methods of measurement are given for a wide range of characteristics. For each of these characteristics, the manufacturer is required or permitted to state a value in the specification of an equipment. This stated value is, by definition, the *rated* value of that characteristic (see Clause 7). The application of the term "rated" in this sense is not restricted to a limited set of major characteristics but may be applied to *any* characteristic for which a method of measurement is given. Since the rated value is the value stated by the manufacturer, the defining title of the "characteristic to be specified" does *not*, in general, include the word "rated"; the rated value is not something which is measured but is decided by the manufacturer, taking into account measurements on many samples of the equipment and theoretical tolerance calculations.

For example, a method of measurement is referred to in this publication and described in IEC Publication 268-3 for the distortion-limited output power of an amplifier. The *rated* distortion-limited output power is the value stated by the manufacturer, usually calculated from measurements (according to the standard method) on several samples of the amplifier, supplemented by tolerance calculations.

7.3 *Interdependent characteristics*

It often happens that the value of one characteristic is required to be stated for a particular value of another characteristic. A prominent example is the noise-limited sensitivity of a receiver, which is stated for a particular value of signal-to-noise ratio.

In such cases, it is necessary to adopt one of the characteristics as a rated condition, and it is preferable to adopt that characteristic the rated value of which is either specified as a reference in a relevant IEC standard or is chosen by the manufacturer more or less arbitrarily within certain practical limits.

Note. — Applying the preferred criterion to the above-mentioned example, the rated signal-to-noise ratio (for which preferred values are given in Parts 3 and 4) is adopted as a rated condition, and the rated noise-limited sensitivity becomes the rated value of a characteristic.

7.4 *Matching values*

A knowledge of the values of certain basic characteristics of two items of equipment, which are to be connected together, is necessary in order to ensure compatibility. These values are known as matching values and are stated by the manufacturer for conditions defined in the relevant parts of the standard. Some matching values are also rated conditions.

8. Climatic conditions

Measurements and mechanical checks may be carried out at any combination of temperature, humidity and air pressure within the following limits:

Ambient temperature:	15 °C to 35 °C, preferably at 20 °C.
Relative humidity:	25% to 75%
Air pressure:	86 kPa to 106 kPa.

For equipment designed to be used in vehicles the ambient temperature limits are 5 °C to 45 °C.

If the manufacturer finds it necessary to specify climatic conditions differing from the above, these should be chosen from IEC Publication 68 and the measurements shall be made under these specified conditions.

The conditions mentioned above represent those under which the equipment is required to meet its specification. Over a wider range the equipment may operate but not meet all of its specifications and it may be permissible to store the equipment under much more extreme conditions. For a more complete discussion of these concepts, reference is required to IEC Publication 68.

9. Individual specification and type specification

Values may be specified either for a general type or for an individual sample of this type.

In the first case, the manufacturer shall state whether the specified values are:

- limits
- statistical "worst case" values (see note)
- average values (see note).

Note. — These values are derived from measurements on a batch and accompanied by the data required to render them significant; see ISO standards on sampling procedures.

10. Graphical presentation of data

10.1 *General*

The relation between two or more quantities is often more clearly presented as a graph rather than as a table.

When the results of a point by point measurement for an individual sample are presented as a continuous curve, the measured points shall be clearly indicated. Extrapolated or intermediate curves based on theoretical expectations or other information presented, but not based on direct measurement, shall be clearly distinguished from measurement curves, for example by another style of drawing.

Where appropriate, data may be presented as a line or band spectrum of constant bandwidth or constant proportional bandwidth. The bandwidth used shall be stated. Preference shall be given to one octave and one-third octave bands as mentioned in Sub-clause 6.1.

10.2 *Scales*

Linear or logarithmic scales are recommended for graphical presentation. Other kinds of scales, such as double logarithmic and combinations of linear and logarithmic, should be avoided. Linear decibel scales are equivalent to logarithmic scales.

Where quantities represented by abscissa and ordinate are of the same kind, the same unit length should be used for both. A remote zero point on linear scales should be avoided as far as possible. The zero reference on decibel scales should, if possible, be the rated value.

For logarithmic frequency scales and polar level diagrams used for presenting the results of audio-frequency measurements, reference is made to IEC Publication 263.

10.2.1 *Logarithmic frequency scales*

For graphs in which a level (in decibels) is plotted against frequency on a logarithmic scale, the scale proportions shall be those for which the length for a 10:1 frequency ratio is equal to the length for a level difference of 50 dB on the ordinate scale.

Notes 1. — The alternative values of level difference (10 dB and 25 dB) given in IEC Publication 263 may be used when appropriate.

2. — Logarithmic frequency scales are mostly used for plotting modulation frequency rather than carrier frequency.

10.2.2 *Polar level diagrams*

For polar plots in which a level in decibels is shown increasing outward along a radius on a linear scale, the maximum level shall preferably be plotted on, or within 2.5 dB of, the reference circle whose radius corresponds to a difference in level of 25 dB. The tolerance on the radius of the reference circle corresponds to ± 0.25 dB. These requirements apply for whatever length is chosen to represent 1 dB.

For an absolute level, when the radius of the reference circle corresponds to 25 dB, the level assigned to the reference circle shall be a multiple of 5 dB.

Note. — If it is necessary to plot a characteristic over a range greater than 25 dB, then a difference in level of 50 dB should be used.

11. Pre-conditioning

In order to ensure that when measurements begin the receiver characteristics do not change significantly with time, the receiver shall be operated under standard measuring conditions for a period of at least 10 min (for small battery-operated receivers) and preferably of at least 1 h (for larger receivers) before recording the results of any measurements.

12. Measurements in a uniform alternating low-frequency magnetic field

12.1 *Method of producing a uniform alternating low-frequency magnetic field*

A convenient and fairly accurate method of producing a uniform alternating magnetic field makes use of the arrangement of three square coils according to Figure 2. Dimension $a = 0.375\ b$,

where a is the distance between the coils and b the dimension of the side of each coil. The coils are supplied with a current at the required frequency.

Between the three coils 1, 2 and 3 having turns in the ratios of

$$\frac{n_1}{100} = \frac{n_2}{36} = \frac{n_3}{100}$$

when the same current I flows through each coil in the same direction, a field is produced that may be considered to be uniform to within ±2%, inside a spherical space having a diameter of $d = 0.5\ b$, the centre of which coincides with the geometrical centre of coil 2.

The resulting magnetic field strength H and magnetic induction B will be approximately:

$$H = 1.35\frac{n_1 I}{b}\ \text{(A/m)} \qquad B = 1.70\frac{n_1 I}{b}\ \text{(μT)}$$

The magnetic field strength shall be measured before the sample under test is placed in the magnetic field. This can be done with a search coil (see Appendix B).

12.2 *Positioning the sample*

The sample under test shall be placed in the magnetic field and the position of the sample relative to the pattern of the field shall be varied until the interference is at maximum.

The sample under test shall not project from the spherical space of diameter d.

13. Types of power supply and relevant measuring conditions

The following types of power supply are defined:

- Mains: any centralized a.c. or d.c. power source, usually having a rated voltage of more than 24 V.
- Batteries: accumulators, primary batteries or any similar energy sources such as solar batteries, thermo-electric cells, etc.

Batteries of the type, voltage and internal resistance specified for use with the receiver shall be employed; other sources, which essentially simulate the characteristics of those specified, may also be used and the substitute arrangements stated with the results.

Receivers intended for use on more than one type of power supply should be measured with each type of power supply.

Note. — In this respect, a.c. mains and d.c. mains are considered as different types of power supply.

To determine the influence of variations in the supply voltages on the characteristics, supplementary measurements may be carried out at overvoltages and undervoltages, these being chosen appropriately with due regard for the manufacturer's specifications.

13.1 *Mains-operated receivers*

13.1.1 The rated voltage at the rated frequency shall be applied to the receiver. For receivers with more than one rated operating voltage or frequency, a specified rated voltage, at a rated frequency, shall be applied.

13.1.2 *Overvoltages and undervoltages*

The rated voltage +10% and the rated voltage −10% at a rated frequency shall be applied.