
Methods of Measuring and expressing the performance of radio receivers for sound broadcasting

Part 1. General conditions

[IEC title : Methods of measurement on radio receivers for various classes of emission.
Part 1 : General conditions for measurements and measuring methods
applying to several types of receivers]

Méthodes de mesurage et d'expression des performances des
récepteurs radioélectriques pour la radiodiffusion sonore
Partie 1. Conditions générales

Verfahren zur Messung und Bezeichnung der Leistung von Radioempfängern für Hörfunk
Teil 1. Allgemeine Bedingungen

National foreword

This British Standard has been prepared under the direction of the Electronic Equipment Standards Committee and is the first Part of a revision of BS 4054 which was first published in 1966. It is identical with IEC Publication 315-1 : 1970 'Methods of measurement on radio receivers for various classes of emission. Part 1 : General conditions for measurements and measuring methods applying to several types of receivers', published by the International Electrotechnical Commission (IEC) and incorporates IEC Publication 315-1A : 1971 'Survey of input arrangements for magnetic aeriels' as an appendix. It also takes into account the content of IEC Erratum Slips issued in 1971 and 1972 and the relevant text affected is marked with a vertical line in the margin.

This British Standard is divided into five Parts of which this is Part 1. The other Parts are as follows :

- Part 2. Measurements related to the audio-frequency part of the receiver
- Part 3. Radio-frequency measurements on receivers for amplitude-modulated emissions
- Part 4. Radio-frequency measurements on receivers for frequency-modulated emissions (In course of preparation)
- Part 5. Measurements on frequency-modulated receivers of the response to impulsive interference.

Discussions are taking place within IEC on the preparation of an international standard that will form the basis of Part 4. Until international agreement is reached, BS 4054 : 1966, with amendments AMD 1451 and AMD 3288, will be retained for r.f. measurements on f.m. receivers.

Terminology and conventions. The text of the international standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards.

Wherever the word 'Recommendation' appears, referring to this standard, it should be read as 'British Standard'.

NOTE 1. References to page numbers relate to the IEC page numbers given in brackets at the bottom of each page.

In clauses 9, 10 and 11, the millibar (mbar) is used as the pressure unit. The following conversion should be noted.

$$1 \text{ mbar} = 10^2 \text{ N/m}^2 = 0.1 \text{ kPa.}$$

NOTE 2. Scope clause (clause 2). The scope clause of the international standard includes a mandatory statement, which is contrary to the practice in British Standards. In the interest of clarity, clause 2 should be read as follows.

'This British Standard specifies general methods of measuring and expressing the performance of radio receivers for sound broadcasting. This Part of BS 4054 specifies the general conditions for measurements and those methods of measurement that are applicable to several types of radio receiver. They are not included in the other specialized Parts.

Appendix A describes methods of producing a standard field for use as the r.f. input signal to receivers having a magnetic aerial.

This standard does not specify limits on the performance of receivers.

NOTE 3. Clause 2 of appendix A is titled 'Scope' : this should be read as 'General'.

Cross-references

International standard*	Corresponding British Standard
IEC 68	BS 2011 Basic environmental testing procedures
Part 1 : 1968	Part 1.1 : 1977 General (Identical)
Part 2 : 1968	Part 2.1 : 1977 Tests (Identical)
IEC 124 : 1960 This publication has been superseded by IEC 268-14 : 1971 (See cross-reference under this number.)	
IEC 268	BS 5428 Methods for specifying and measuring the characteristics of sound system equipment
Part 5 : 1972	Part 11 : 1977 Loudspeakers (Identical)
Part 14 : 1971	Part 5 : Mechanical design features (In course of preparation) (Identical)
IEC 315 (superseding IEC 69 : 1954)	BS 4054 Methods of measuring and expressing the performance of radio receivers for sound broadcasting
Part 2 : 1971	Part 2 : 1980 Measurements related to the audio-frequency part of the receiver (Technically equivalent)
ISO/226-1975	BS 3593 : 1963 Recommendation on preferred frequencies for acoustical measurements (Technically equivalent)

Related British Standards for IEC 65, IEC 86 and IEC 106 are BS 415, BS 397 and BS 905 respectively.

At present there is no corresponding British Standard for IEC 284 : 1968. The technical committee has reviewed its provisions and has decided that it is acceptable for use in conjunction with this standard.

* Undated in the IEC text.

Additional information. When using this British Standard, the following points should be noted.

Table IV. Geographical Region I is applicable to the United Kingdom.

IMPORTANT NOTE. It is essential that this Part be read, where applicable, in conjunction with the other Parts of this British Standard.

NOTE. Textual errors. When the text of the international standard was adopted, the errors listed below were noticed. They have been reported to IEC in a proposal to amend the text of the international standard.

Figure 1. The designation of the horizontal axis ' $E \rightarrow \mu\text{J}(\mu\text{W s})$ ' should be read as ' $E \rightarrow \mu\text{J}(\mu\text{W s})$ '. In the designation of the vertical axis, ' u ' should be read as ' U '.

Tables II, III and IV of appendix A. In the headings of these tables, the symbol ' K ' should be printed thus, i.e. in sloping, not upright type.

Tables III and IV of appendix A. In the headings of these tables, '1 MHz' should be printed thus, i.e. in upright, not in sloping type.

Clause 41. The reference, in line 5, to clause 18, should be read as '(see clause 56)'.

Appendix A. In line 1 of column 3 of table 1 and in the note to clause 9, '2.5 MHz' should be read as '4 MHz' in order to be consistent with the corresponding value given for method B.

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A. Survey of input arrangements for magnetic aerials

[First supplement to IEC Publication 315-1 (1970)]

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British Standard Methods of

Measuring and expressing the performance of radio receivers for sound broadcasting

Part 1. General conditions

CHAPTER I : GENERAL SECTION ONE – INTRODUCTION

1. Object

This Recommendation is intended to standardize the conditions and methods of measurement to be used to determine the characteristics of a radio receiver, so as to make possible the comparison of results of measurements made by different observers. Limiting values of the various quantities for acceptable performance are not specified.

It constitutes a catalogue of selected measurements, recommended for assessing the essential properties of radio receivers. It is neither mandatory nor limiting, a choice of measurements being made in each particular case. If necessary, additional measurements may be carried out, if applicable, in accordance with recommendations laid down by other IEC Technical Committees or Sub-Committees or by other international bodies.

The methods of measurement are generally conceived to permit analyzing the over-all performance of the receiver, considered as a quadripole (two-port), without endeavouring to study its elements separately.

However, depending on the characteristic to be measured and the type of the receiver, it may be practicable, for experimental simplification or other reasons, to carry out measurements on parts of the receiver by injection or extraction of signals at appropriate places in its circuits.

2. Scope

This Part, which shall be used, if applicable, in conjunction with the other parts of this Publication, describes general conditions for measurements to be applied to various types of radio receivers, including particularly those for broadcast transmissions.

It also describes such methods of measurement which are deemed to be applicable to several types of radio receivers and therefore do not appear in other specialized parts.

SECTION TWO – GENERAL NOTES ON MEASUREMENTS

3. Introduction

As the results of various measurements, described in other parts of this Publication, may be influenced by properties dealt with in this Part, it is recommended that the appropriate related measurements contained in this Part shall be carried out first.

All measurements shall, unless specified otherwise, be carried out under the conditions specified in the relevant clauses of this part, whilst the following points shall also be taken into consideration.

4. Description of measuring conditions

A description of the conditions under which the measurement has been made, the set-up of the measuring equipment, including external circuit elements, the applied signal levels, the applicable

environmental conditions and, if applicable, the coding of the type of measurement shall be added to the results.

5. Accuracy of measuring instruments

The accuracy of the measuring instruments used, if known, shall either be stated as a percentage, or as the accuracy class laid down in the relevant Publications (under consideration).

6. Presentation of results

If the results of measurements are presented graphically, the points which have been obtained experimentally shall always be indicated on the graph, together with other specifically required data of the measurements. If a continuous record has been made, this shall be stated.

7. Deviations

If deviations from the recommended methods are adopted, they shall be explicitly stated with the results.

SECTION THREE – ENVIRONMENTAL CONDITIONS

8. Introduction

Unless otherwise specified, the following standard atmospheric conditions apply for the purposes mentioned in Clauses 9, 10 and 11 (in accordance with IEC Publication 68-1, Basic Environmental Testing Procedures, Part 1: General (Third edition)).

Other environmental conditions are referred to in Clause 12.

9. Standard reference conditions

If the quantities to be measured depend on temperature and/or air pressure and the law of dependence is known, the values are measured under the conditions given in Clause 11 and, if necessary, corrected by calculation to the following reference values:

Temperature: + 20 °C
Air pressure: 1 013 mbar

Note. – No requirements for relative humidity are given here, because a correction by calculation is generally not possible.

10. Standard referee conditions

If the quantities to be measured depend on temperature, humidity and air pressure and the law of dependence is unknown, the measurements may be made, by mutual agreement, at one of the following conditions:

Temperature	Relative humidity	Air pressure
+20 ± 1 °C	63% — 67%	860 mbar — 1 060 mbar
+23 ± 1 °C	48% — 52%	860 mbar — 1 060 mbar
+25 ± 1 °C	48% — 52%	860 mbar — 1 060 mbar
+27 ± 1 °C	63% — 67%	860 mbar — 1 060 mbar

When the temperature of measurement differs from 20 deg C or such other temperature as may be prescribed in the relevant specification, suitable limits for the characteristic values shall be agreed between purchaser and manufacturer.

The test report shall give the actual values of temperature, relative humidity and air pressure during the measurements.

For large equipment or test rooms, where temperature, relative humidity and air pressure limits as indicated above are difficult to maintain, wider tolerances are allowed, subject to mutual agreement. The actual values shall be given in the test report.

11. Standard testing conditions

Measurements and mechanical tests are normally carried out at any existing combination of temperature, humidity and air pressure within the following limits:

Temperature:	+ 15 °C to + 35 °C
Relative humidity:	45% to 75%
Air pressure:	860 mbar to 1 060 mbar

In addition, for receivers incorporating transistors, e.g. portable and motorcar receivers, certain measurements (e.g. of sensitivity and power output) shall also be made at 5 °C and 45 °C, the latter case being to check the thermal stability.

The temperature and relative humidity shall be substantially constant during a series of measurements carried out as a part of one test on one equipment.

Where it is impracticable to carry out measurements under these standard atmospheric conditions for testing, a note to this effect, stating the actual conditions, shall be added to the test report.

12. Other environmental conditions

When, by mutual agreement, the essential properties of radio receivers have to be assessed in environmental conditions other than those laid down in Clauses 10 and 11, the measurements shall be made during or after subjection to such conditions as laid down in IEC Publications 68-2, Basic Environmental Testing Procedures, Part 2: Tests, and as required according to the relevant specification sheets.

SECTION FOUR – PRECAUTIONS DURING MEASUREMENTS

13. Damage to equipment

When carrying out measurements on a receiver, all conditions or operations which may lead to damage of the receiver and/or its tubes, valves or semi-conductor devices, shall be avoided. This applies particularly to integrated circuit devices and similar constructions.

14. Safety arrangements

If a protecting cover is removed and parts which are directly connected to the mains (e.g. the chassis) become accessible, it is recommended, for the safety of personnel performing measurements, that equipment be connected to the a.c. mains via a safety transformer, the secondary winding of which is insulated in accordance with the principle of double insulation.

It shall be ascertained that the use of a safety transformer does not influence the receiver properties to be measured. If a safety transformer is not used, the safety aspect shall be taken care of by other means. (See also IEC Publication 284, Rules of Behaviour with Respect to Possible Hazards when dealing with Electronic Equipment and Equipment Employing Similar Techniques (First edition).)

SECTION FIVE – POWER SUPPLY

15. Types of power supply and relevant measuring conditions

The following ways of operation with regard to power supply are defined:

Mains: operation from any centralized a.c. or d.c. power source with a nominal operating voltage of more than 24 V.

Batteries: operation on accumulators, primary batteries or any similar energy sources, e.g. solar batteries, thermo-electric cells, etc.

Accumulators, primary batteries, and/or other similar energy sources, of the type, voltage and internal resistance, as specified for use with the receiver, shall be employed; other sources, which sensibly 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 shall be measured by connecting the receiver to each type of power supply in turn.

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

The normal measuring conditions, as laid down in Clauses 16, 18 or 20, whichever are applicable, shall apply for all measurements.

To determine the influence of variations in the supply voltages on various characteristics of a radio receiver, supplementary measurements shall, unless otherwise specified, be carried out at overvoltages and undervoltages, whichever are applicable, deviating from the chosen rated values, and laid down in Clauses 17, 19, 21 and 22.

The conditions chosen shall be stated. See also Table I, page 21.

16. Mains-operated receivers - normal conditions

The rated voltage at the rated frequency shall be applied to the mains terminal device.

For receivers with more than one rated operating voltage or frequency, a specified rated voltage, at a rated frequency, shall be applied to the mains terminal device.

17. Mains-operated receivers - overvoltages and undervoltages

The rated voltage $+10\%$ and the rated voltage -10% , at a rated frequency, shall be applied to the mains terminal device.

For receivers with more than one rated operating voltage or frequency: the highest rated voltage $+10\%$ at the lowest rated frequency and the lowest rated voltage -10% at the highest rated frequency shall be applied to the mains terminal device; where tapings for a range of voltages are provided, the appropriate range shall be selected for the measurements.

18. Accumulator-operated receivers - normal conditions

The normal operating voltage for accumulator batteries is fixed at 2.0 V per cell for lead batteries not under charge, 2.2 V per cell for lead batteries under charge and 2.4 V per cell for car batteries,

measured at the terminals of the battery. If accumulators other than lead accumulators are used, these voltages per cell shall be chosen accordingly and stated with the results (see also Table I, page 21).

19. Accumulator-operated receivers - overvoltages and undervoltages

The undervoltage for lead accumulators is fixed at 1.8 V per cell. The overvoltage for lead accumulators of motor-cars is fixed at 2.6 V per cell. If accumulators other than lead accumulators are used, the undervoltage and overvoltage per cell shall be chosen accordingly and stated with the results (see also Table I).

Note. – For batteries in vehicles, switching peaks of very short duration and nearly double the normal operating voltage may occur, whilst at low operating temperatures higher voltages may be encountered, due to higher internal resistance of the cells.

20. Primary battery-operated receivers - normal conditions

The normal operating voltages for primary batteries are generally to be found in the relevant IEC Publication 86, Primary Cells and Batteries. The normal operating voltage for primary batteries of the Leclanché type is fixed at 1.5 V per cell; if other voltages apply, these shall be stated with the result.

21. Primary battery-operated receivers with tubes or valves - undervoltages

The undervoltage on load for primary batteries of the Leclanché type shall be 1.10 V per cell for batteries supplying filament voltage and 1.00 V per cell for batteries supplying anode voltage.

Normally, undervoltages shall be obtained by using adjustable resistors in series with fresh batteries or any other sources of the rated voltages having negligible internal resistance. Under the conditions of the particular test in progress, the series resistor shall be adjusted once and for all, to obtain the specified undervoltages on full load of the receiver, e.g. delivering the highest useful output power at the undervoltage, see Clause 32 of IEC Publication 315-2 (in preparation).

Alternatively, under special circumstances, the undervoltage may be obtained in a similar way using an initial voltage source of a specified percentage, e.g. 20%, below the rated voltage value, with an appropriately smaller value for the series resistance; this deviation from the normal procedure shall be explicitly stated with the results.

22. Primary battery-operated receivers with transistors - undervoltages

The undervoltage on load for primary batteries of the Leclanché type shall generally be 0.90 V per cell, the receiver delivering the highest useful output power at the undervoltage (see Clause 32 of IEC Publication 315-2). If required, additional tests at an undervoltage of 0.75 V per cell may be applied.

The undervoltage shall be obtained as indicated in Clause 21.

23. Additional information

Table I gives a survey of the different overvoltages and undervoltages for various types of operation.

If, during operation at the extreme voltages specified in this section, the receiver is unstable, or if the local oscillator fails, measurements shall be made at less extreme voltages. A clear statement of these conditions shall be added to the results.

If the undervoltage is to be (partly) obtained by a resistor in series with an adjustable constant voltage source, as prescribed in Clauses 21 and 22, it is convenient to apply first the relevant undervoltage directly, with the adjustable series resistor set at zero resistance, and to adjust the various parameters of the receiver as required. Then, without changing these parameters, the normal operating voltage is applied, the adjustable resistor being set at maximum resistance, after which the resistance shall be gradually decreased until the same chosen undervoltage is reached. Unless the receiver is unstable, its performance should be identical with the previous one. The series resistance shall be kept constant during further tests with the same equipment.

TABLE I
Survey of voltages for various types of power supply

1	2	3	4	5
Type of power supply for radio receivers	Rated voltage V	Operating voltage		
		normal V	maximum V	minimum V
<i>Mains</i>	<i>U</i>	<i>U</i>	<i>U + 10%</i>	<i>U - 10%</i>
<i>Primary battery *</i> For receivers with tubes or valves, full load: — for filament supply — for anode supply For transistor receivers (delivering highest useful output power at the applied voltage)	1.5	1.5	1.5 1.5 1.5	1.10 1.00 0.90 0.75 **
<i>Accumulator *</i> <i>Lead accumulators</i> — under charge — for car receivers <i>Nickel-cadmium accumulators with incorporated gas-vent</i> — under charge — for car receivers <i>Nickel-cadmium accumulators of the sealed type</i> — under charge — for car receivers	2.0 1.2 1.2	2.0 2.2 2.4 1.2 1.4 1.2 1.35	 2.6 1.6 1.4	1.8 1.1 1.1
* Voltage per cell. ** Only if required.				

24. Power and current consumption of receivers

The power and/or current consumption of receivers shall be measured under normal measuring conditions (see Clause 16, Clause 18 and/or Clause 20), for each of the following conditions, with the exception of item *c*), which is only intended for receivers with a class B amplifier as the audio-frequency output stage, e.g.:

- without a radio-frequency input signal (if the receiver is equipped with a muting circuit, this shall be in operation);
- with a radio-frequency input signal, modulated 30% at the standard reference frequency, the receiver delivering the reference output power (see Clause 31 of IEC Publication 315-2);

- c) with a radio-frequency input signal, modulated 30% at the standard reference frequency, the receiver delivering 40% of the reference output power. (This empirical value is deemed to correspond to a power or current consumption equal to that during use under normal broadcast conditions.)
- d) with a radio-frequency input signal, the receiver delivering the maximum useful output power; if necessary, the modulation factor may be increased up to 100%;
- e) if applicable, with an audio-frequency input signal, the receiver delivering the maximum useful output power.

In order to prevent overloading, neither the maximum permissible audio-frequency input level (see Section Eleven of IEC Publication 315-2) nor the maximum permissible radio-frequency input signal (see the relevant part, covering the radio-frequency properties of the receiver under test) shall be exceeded.

The measurements may be repeated at overvoltages and undervoltages (see Clauses 17, 19, 21 and 22).

The type of power supply and the operating conditions during the measurements shall be stated.

SECTION SIX – TOLERATION OF SURGE DISCHARGES OF LIMITED ENERGY, APPLIED TO THE AERIAL INPUT CIRCUIT

25. Introduction

Some receivers, for instance receivers using semi-conductor devices in the input stages, when connected to an open aerial, are liable to be damaged by surge discharges of limited energy to or from this aerial. Such surge discharges mainly occur when using outside aerials, either during thunderstorms or, in the case of a car aerial, by discharging the body of the car, when the aerial is accidentally connected to earth by any means.

Direct lightning discharges are not dealt with in this section.

The ability of the input circuit of a receiver to endure surge discharges is measured by the surge voltage, expressed in kV, or by the surge energy, expressed in microjoules (microwatt seconds), at which any semi-conductor device or other component in the receiver still does not break down.

If protective devices are incorporated in the receiver, their properties may influence the behaviour of the input circuit, so that the energy that the circuit can withstand is dependent on the applied voltage. Therefore, a capacitor with a fixed value (1 500 pF) is chosen as a means of applying the surge. The value of the maximum permissible surge energy, together with the applied voltage, shall be stated by the manufacturer to avoid any possible infringement of Clause 13.

The applied voltage and the surge energy have a fixed interrelation according to the following formula:

$$E = \frac{1}{2} CU^2$$

where:

E = surge energy, in joules (watt-seconds)

C = capacitance, in farads

U = applied voltage, in volts

The same formula applies for E , C and U respectively expressed in microjoules, picofarads and kilovolts. For $C = 1\,500\text{ pF}$, the following relations apply:

$$E_{(1\,500\text{ pF})} = 750 U^2 \text{ (in kilovolts) microjoule, or: } U_{(1\,500\text{ pF})} = \sqrt{\frac{E \text{ (in } \mu\text{J)}}{750}} \text{ kV}$$

Figure 1 gives a curve to show this relation.

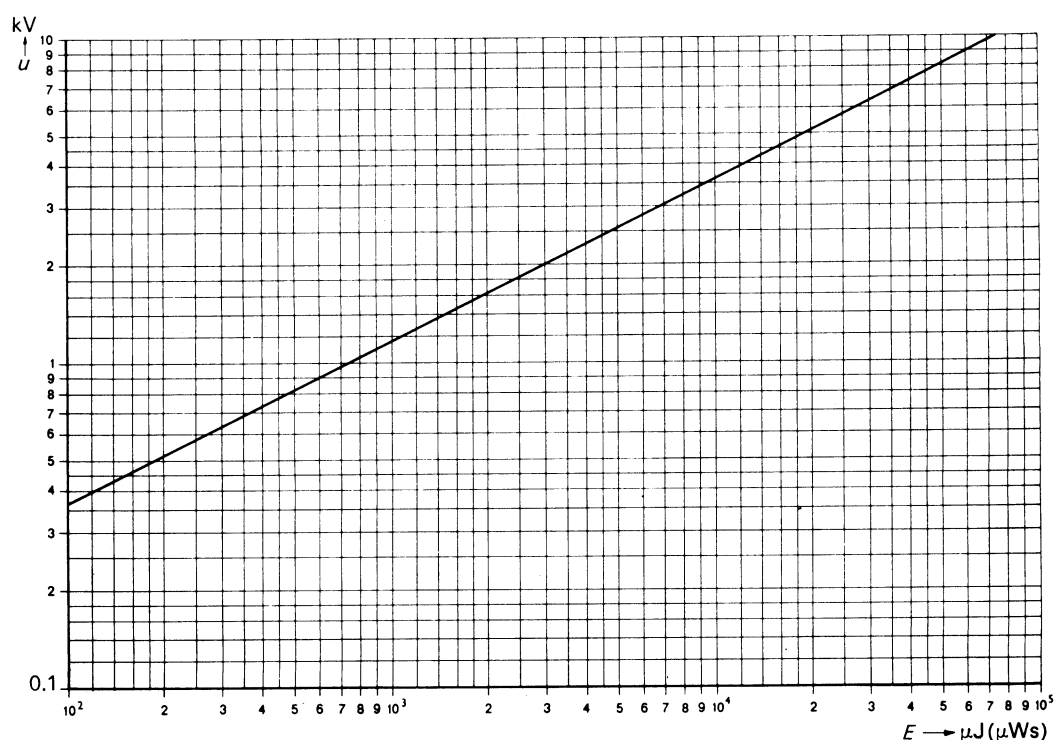


FIG. 1.—Applied voltage U as a function of the surge energy E for a capacitor of 1 500 pF.

26. Method of test

To check whether the receiver complies with the relevant statement of the manufacturer, the following test is applied.

The receiver shall be in operation, receiving any suitable signal by means of a small aerial having a capacitance less than 10 pF, a connection to earth being applied.

A surge discharge device is also connected to the aerial and earth terminals of the receiver under test. The surge discharge device consists of a capacitor of 1 500 pF, earthed at one side which, in turn, is charged by an adjustable voltage source (e.g., 0 kV to 10 kV), and discharged, through the input circuit of the receiver, by means of a switch or relay connected to the aerial terminal through a current-limiting resistor of 2 000 Ω .

Figure 2, page 27, gives an example of the arrangement for measuring the toleration of surge discharges.

Figure 3, page 27, gives an example of the relevant switching device, in the form of a relay.

With the switch in the “charge” position C, the voltage source is adjusted for the specified voltage or for the voltage corresponding to the specified surge energy as derived from Figure 1, whichever is applicable.

The switch (or the relay) shall then be manipulated at least ten times from the “charge” position C to the “discharge” position D and back.

If the receiver, after this series of discharges, is still in normal operating condition, it is deemed to comply with the statement of the manufacturer for the applied d.c. polarity.

The test shall be repeated after reversing the polarity of the adjustable voltage source.

Warning : The aerial used for normal operation shall not be connected to the receiver, because:

- a) its capacitance to earth would absorb part of the discharge energy;
- b) a dangerous voltage may be applied to it. (At an applied voltage of 3 kV, the maximum permissible discharge of $4.5 \mu\text{C}$, as laid down in I E C Publication 65, Safety Requirements for Mains Operated Electronic and Related Equipment for Domestic and Similar General Use, Sub-clause 9.1.1, item a), is reached.)

The small aerial used for the test shall not be touched during the test and shall be discharged to earth when the measurements are completed, to avoid risk of shock (see item b)).

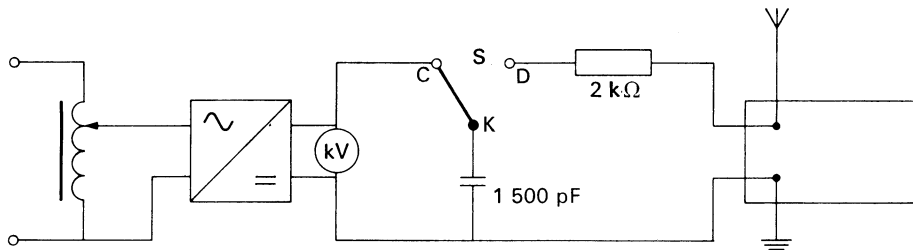
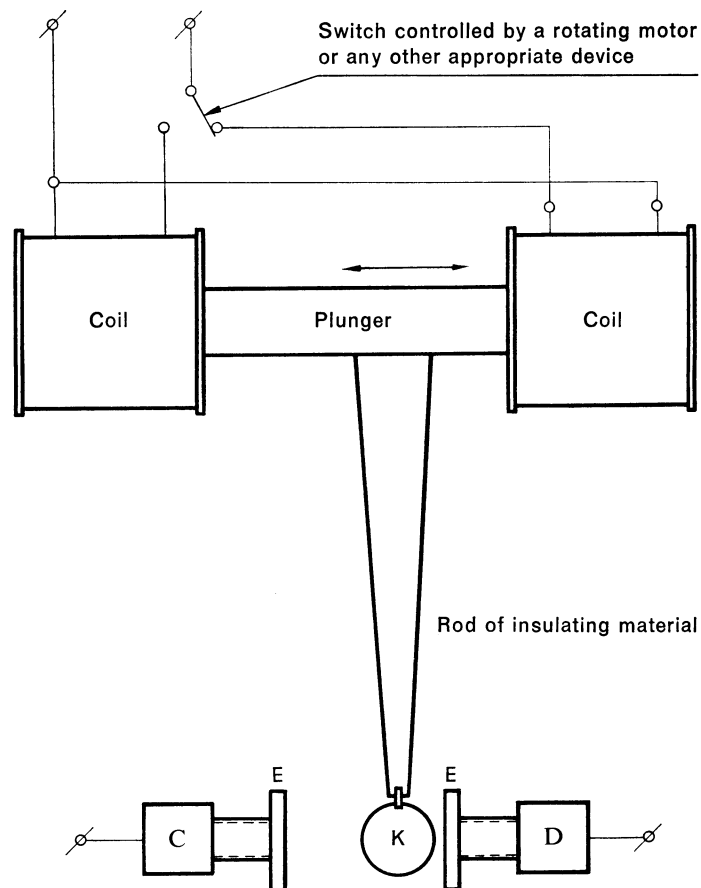


FIG. 2. — Example of the arrangement for measuring the toleration of surge discharges applied to the aerial input circuit.



The brass pillars C and D support circular electrodes E spaced at a distance of 15 mm; K is a brass sphere of 7 mm diameter and is supported on a rigid rod of insulating material approximately 150 mm long. C, D and K are connected as shown in Figure 2, K by means of a flexible wire. Care must be taken to avoid bouncing of sphere K.

FIG. 3. — Example of the switching device S in Figure 2.

CHAPTER II : AUDIO-FREQUENCY SIGNALS

SECTION SEVEN – GENERAL NOTES ON AUDIO-FREQUENCY SIGNALS

27. Introduction

Since in various measurements the output power is used as an indication of the correct adjustment of a receiver, a method of measurement of output power and clauses of a relevant general nature are included in this chapter. Other measurements for the evaluation of the audio-frequency properties of a receiver are given in I E C Publication 315-2.

To facilitate the comparison of results and to promote their reproducibility, the following points shall also be taken into consideration when measuring output power or other audio-frequency properties.

28. Setting of tone controls

Unless otherwise stated, the tone controls shall be set to give the most uniform response over the greatest part of the audio-frequency range. The response referred to is either the electrical or the acoustic response, depending on how the output is prescribed to be measured; the method used shall be stated with the results. Once established, this reference setting shall, for all measurements, be designated as the “normal setting of the tone controls”, unless the manufacturer has specified another normal setting of the tone controls to be used as a reference.

29. Setting of selectivity controls

Unless otherwise stated, the selectivity control(s) shall be set to give the widest possible radio-frequency pass-band. See the relevant part, covering the radio-frequency properties of the receiver under test.

SECTION EIGHT – RECOMMENDED AUDIO-FREQUENCIES FOR MEASUREMENTS

30. Introduction

To facilitate the comparison of results, the selection of audio-frequencies for receiver measurements shall preferably be restricted to a minimum, as stated in the ISO Recommendation dealing with acoustics.

If a continuous record is not required, measurements shall preferably be made at one of these preferred frequencies. The degree of preference is indicated by the type of printing in the relevant table.

31. General table of preferred frequencies

In Table II,* a list of preferred frequencies is given, with a ratio of approximately $10^{0.05}$.

This table applies to radio frequencies as well as to audio-frequencies, the former being expressed either in kilohertz or megahertz. The $\times$'s in the columns indicate the frequencies to be used when the interval is one, a half or a third octave.

Notes 1. – The frequencies in the table have been rounded slightly for ordinary use; for example, 500 is listed instead of the more precise 501.87. The maximum error is 1.22%.

2. – For certain purposes, it may be necessary to make measurements at frequencies other than those indicated in the table, e.g. at frequencies at which anomalies are observed.

* Identical to the table of ISO Recommendation R266.

TABLE II

Preferred frequencies in hertz, kilohertz or megahertz

Preferred frequencies	Interval in octave			Preferred frequencies	Interval in octave			Preferred frequencies	Interval in octave		
	1	$\frac{1}{2}$	$\frac{1}{3}$		1	$\frac{1}{2}$	$\frac{1}{3}$		1	$\frac{1}{2}$	$\frac{1}{3}$
16	×	×	×	160			×	1 600			×
18				180		×		1 800			
20			×	200			×	2 000	×	×	×
22.4		×		224				2 240			
25			×	250	×	×	×	2 500			×
28				280				2 800		×	
31.5	×	×	×	315			×	3 150			×
35.5				355		×		3 550			
40			×	400			×	4 000	×	×	×
45		×		450				4 500			
50			×	500	×	×	×	5 000			×
56				560				5 600		×	
63	×	×	×	630			×	6 300			×
71				710		×		7 100			
80			×	800			×	8 000	×	×	×
90		×		900				9 000			
100			×	<u>1 000</u>	×	×	×	10 000			×
112				1 120				11 200		×	
125	×	×	×	1 250			×	12 500			×
140				1 400		×		14 000			
160			×	1 600			×	16 000	×	×	×

32. Standard reference frequency

The standard reference frequency for all audio-frequency measurements and for adjustment purposes is 1 kHz.

Notes 1.—This value is in accordance with the ISO Recommendation R266.

2.—For the time being, a reference frequency of 400 Hz may be temporarily accepted.

SECTION NINE – AUDIO-FREQUENCY OUTPUT POWER

33. Introduction

The audio-frequency output power is the electrical power consumed in the real load or in an audio-frequency substitute load specified for tests on the receiver.

Table III gives a survey of the various concepts of output power, with references to the relevant clauses.

TABLE III

Survey of concepts of output power

Concepts	Laid down in I E C Publication	Measured or determined according to I E C Publication
Audio-frequency output power	315-1, Clause 33	315-1, Clause 35
Standard output power	315-1, Clause 36	315-1, Clause 35
Maximum useful output power	315-2, Clause 29	315-2, Clause 32
Highest useful output power	315-2, Clause 30	315-2, Clause 32
Reference output power	315-2, Clause 31	315-2, Clauses 31 and 32

34. Audio-frequency substitute load

Unless otherwise specified, the audio-frequency substitute load is a resistance of a specified value, which is to be substituted for the moving coil of the loudspeaker, for any other output transducer, or for the characteristic impedance of a transmission line, whichever is applicable, when measuring the output power at the relevant terminals.

This value is to be specified by the manufacturer.

The definition implies that an output transformer is considered to be an integral part of the receiving equipment, even if placed elsewhere, e.g. on a loudspeaker.

If the specification of this value is not available, for a full-range single moving-coil loudspeaker of the direct radiator type, the modulus of the lowest value of the electrical impedance in the frequency range above the bass resonance of the loudspeaker shall be chosen (derived from I E C Publication 124, Recommendations for the Rated Impedances and Dimensions of Loudspeakers, and I E C Publication 268-5, Sound System Equipment, Part 5: Sound System Loudspeakers (in preparation)).

35. Method of measurement of output power

The audio-frequency substitute load or the loudspeaker of the receiver shall be connected to the output circuit of the receiver during the measurement of the output power (see also the third paragraph of Clause 34). When the loudspeaker is used as the load, the modulus and phase angle of the speech coil impedance shall be taken into account in the calculation of the output power.

The indication on the instrument for measuring the output power shall be based on the measurement of r.m.s. values of voltage and/or current. If necessary, filters shall be introduced into the output meter circuit for the reduction of hum, noise or other interference, provided that their attenuation is taken into account in the calibration, and provided that the impedance presented to the receiver is maintained in accordance with Clause 34. The output power is expressed in dB(mW) or in milliwatts or watts.

36. Standard output power

Four different levels are recommended as levels of standard output power:

500 mW	50 mW	5 mW	1 mW
or:			
27 dB(mW)	17 dB(mW)	7 dB(mW)	0 dB(mW)

Where applicable, 50 mW shall be considered as the preferred value. In any case, the level chosen shall be stated with the results.

CHAPTER III : RADIO-FREQUENCY SIGNALS

SECTION TEN – GENERAL NOTES ON RADIO-FREQUENCY INPUT SIGNALS

37. Introduction

To facilitate the comparison of results, the selection of radio-frequency input signals with regard to measuring frequencies, input arrangements and input signal levels for receiver measurements shall preferably be restricted to a minimum, chosen from those given in this chapter. For general methods of tuning, reference is made to Chapter IV. For special methods of tuning, see the relevant part, covering the radio-frequency properties of the receiver under test.

The following general points shall also be taken into consideration.

38. Recommended value of modulation factor

If a modulated radio-frequency signal is required, the value of the modulation factor shall be 30 %, unless otherwise specified.

Notes 1. – In the case where a modulation factor higher than 30 % is used, it is necessary to ensure that the harmonic distortion resulting from the modulation of the signal generator remains sufficiently low.

2. – The modulation factor of a frequency-modulated radio-frequency signal is the ratio, usually expressed as a percentage, between the peak frequency deviation, due to the modulation, and the maximum rated system deviation. The term “utilization factor” has been assigned to this ratio by the IEC.

39. Pre-emphasis

Where radio receiving equipment has been designed for compatibility with a system including pre-emphasis, it may be desirable for certain measurements to apply a modulated input signal, including pre-emphasis with the same characteristic as that of the system for which the equipment has been designed.

Note. – If the de-emphasis characteristic of the equipment is not known, it may be determined approximately from the response/modulation-frequency characteristic established at a constant modulation factor (see the relevant part, covering the radio-frequency properties of the receiver under test).