

Methods of

Measurement for radio equipment used in the mobile services —

**Part 4: Transmitters employing
single-sideband emissions (A3A, A3H or
A3J)**

UDC 621.396.9 – 182.3:621.317:621.396.61 * A3A, A3H, A3J

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- Department of Industry (National Physical Laboratory)
- Electrical, Electronic, Telecommunications and Plumbing Union
- Electricity Supply Industry in England and Wales
- Electronic Components Industry Federation
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- Oil Companies Materials Association
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- British Broadcasting Corporation
- Home Office
- Independent Broadcasting Authority
- Ministry of Defence
- Radio, Electrical and Television Retailers' Association
- Radio Society of Great Britain

This British Standard, having been prepared under the direction of the Electronic Equipment Standards Committee, was published under the authority of the Executive Board and comes into effect on 30 October 1981

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National foreword

This British Standard has been prepared under the direction of the Electronic Equipment Standards Committee. It is identical with IEC Publication 489-4:1979 “Methods of measurement for radio equipment used in the mobile services. Part 4: Transmitters employing single-sideband emissions (A3A, A3H or A3J)” published by the International Electrotechnical Commission (IEC).

This Part should be read, where applicable, in conjunction with Part 1 of this standard.

NOTE The emission designations A3A, A3H and A3J used in this British Standard are those which were given in Article 2 of the ITU¹⁾ Radio Regulations prior to the World Administrative Radio Conference held in 1979 (WARC —’ 79). New designations for emissions were agreed at WARC —’ 79 and will be incorporated into this British Standard when the changes are made to the corresponding part of IEC Publication 489.

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

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

Cross-references

International Standard	Corresponding British Standard
IEC 489	BS 6160 <i>Methods of measurement for radio equipment used in the mobile services</i>
IEC 489-1:1976	Part 1:1981 <i>General definitions and standard conditions of measurement</i> (Identical)
IEC 489-5:1979	Part 5:1981 <i>Receivers employing single-sideband techniques (A3A, A3H or A3J)</i> (Identical)

There is no corresponding British Standard for IEC 244-6 referred to in 9.7.1. The Technical Committee has reviewed the provisions of IEC 244-6 and has decided that they are acceptable for use in conjunction with this standard.

There are no corresponding British Standards for IEC 106 and C.I.S.P.R. Publications 2, 2A and 4 but the references are for information only and therefore the validity of this standard is not affected.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 26, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

¹⁾ International Telecommunications Union.

Section 1. Supplementary definitions and conditions of measurement

1 Scope

This standard refers specifically to mobile radio transmitters having audio-frequency bandwidths generally not exceeding 10 kHz for the transmission of voice and other types of signals, using single-sideband amplitude modulation with full, reduced or suppressed carrier.

This standard is intended to be used in conjunction with IEC Publication 489-1: Part 1: General Definitions and Standard Conditions of Measurement. The supplementary terms and definitions and the conditions of measurement set forth in this standard are intended for type tests and may be used also for acceptance tests.

2 Object

The object of this standard is to standardize the definitions, the conditions and the methods of measurement used to ascertain the performance of transmitters within the scope of this standard and to make possible a meaningful comparison of the results of measurements made by different observers and on different equipment.

3 Supplementary terms and definitions

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

3.1

input simulation network (see Figure 1, page 2)

a weighting network which modifies the characteristics of an audio-frequency generator so that it simulates the amplitude/frequency characteristics of a device which produces an electrical signal as a result of a physical change

3.2

reference sideband power

the power of one necessary sideband established during the measurement of the rated radio-frequency output power (see Sub-clause 8.2)

3.3

peak envelope power (P_p)

the average power supplied to the transmission line by a transmitter during one radio-frequency cycle at the highest crest of the modulation envelope (ITU RR1-20, 95; 1976)

3.4

standard test modulations (A) and (B)

standard test modulation (A) is the modulation due to a sinusoidal input-signal of 1 000 Hz at a level to produce the reference sideband power

standard test modulation (B) is the modulation due to two sinusoidal input signals of 1 000 Hz and 1 600 Hz, each of which produces a sideband having a level equal to the reference sideband power

3.5

antenna/aerial

in this standard, the term “antenna” is synonymous with “aerial”

4 Standard test conditions

Unless otherwise specified, all measurements shall be performed under the general test conditions as stated in IEC Publication 489-1 and the supplementary test conditions given below.

4.1 Radiation measurements

For absolute measurements, a suitable test site, equipped with radiation measurements equipment, shall be used.

For relative measurements, a radiation coupling system, for example a test fixture having stable characteristics over the range of measurement frequencies, shall be used. In this case, the output terminals of the test fixture shall be treated as the output terminals of the transmitter.

5 Supplementary test conditions

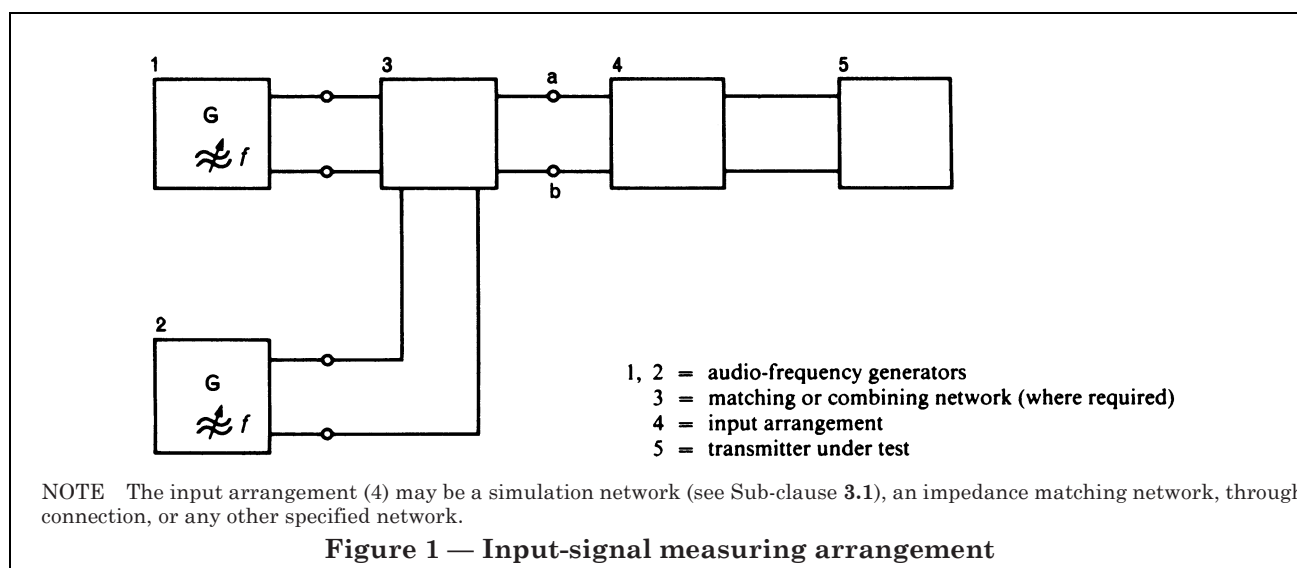
5.1 Connections to the measuring equipment

Care must be taken to ensure that the measuring equipment and any coupling devices do not adversely affect the transmitter loading conditions.

5.2 Input-signal measuring arrangement for transmitters having accessible input terminals

5.2.1 Input-signal source

The input-signal source shall consist of one or more audio-frequency generators connected to the transmitter input terminals as shown in Figure 1, page 2.



5.2.2 Input-signal voltage

The composite voltage across terminals a) and b) of the arrangement shown in Figure 1, expressed in terms of the individual voltages.

5.2.3 Reference input-signal voltage

The r.m.s. input voltage that produces standard test modulation (A).

5.3 Modulation limiting

The modulation limiter, if present, shall be adjusted for normal operation unless otherwise specified.

5.4 Pre-emphasis

Pre-emphasis networks, if included in the transmitter, shall be operative unless otherwise specified.

5.5 Test load for transmitters having accessible antenna terminals

A non-radiating load, with an impedance and power rating specified by the transmitter manufacturer, to replace the antenna including any associated transmission line, when the transmitter is being tested.

5.6 Test load for transmitters without accessible antenna terminals

The test load shall be the antenna supplied by the manufacturer.

5.7 Limitation of the audio-frequency band

Because some properties, for example noise and audio-frequency harmonic distortion, depend upon the audio-frequency bandwidth of the test equipment, reproducible results can be obtained only when the band of audio frequencies occupied by the demodulated signal is restricted to specified limits.

This restriction may be accomplished by means of a band-limiting filter preceding any audio-frequency measuring device. The filter may be incorporated within the measuring equipment. When measuring residual hum and noise, only the low-pass portion of the filter need be specified.

6 Characteristics of the measuring equipment

Recommended characteristics of the measuring equipment are given in Appendix A.

Section 2. Methods of measurement

7 Frequency error

7.1 Definition

Frequency error is the difference between the unmodulated carrier frequency and the assigned carrier frequency. The frequency error is expressed in parts per 10^6 or in hertz.

7.2 Method of measurement

The frequency error is determined by measuring the carrier frequency in the absence of modulation.

The accuracy of the measuring device must be at least ten times more precise than the frequency tolerance given in the equipment specification. If the carrier level is too low for direct measurement, the frequency of a sideband component may be measured when the transmitter is modulated with a precisely known frequency, for example 1 000 Hz. The frequency error may then be calculated taking this difference into account.

NOTE Care should be taken to ensure that the measurement is not affected by unwanted modulation products, such as hum.

If required, the measurements may be repeated on each channel for which the transmitter is equipped to operate.

8 Terminal radio-frequency power

This clause is applicable to transmitters equipped with suitable antenna terminals.

8.1 General

The terminal radio-frequency power of a transmitter may contain:

- a carrier component (Sub-clause 8.2 and 8.3);
- modulation components determining transmission quality, situated within the necessary bandwidth (Clauses 12, 13, 14 and 15);
- modulation components situated outside the necessary bandwidth (Sub-clause 8.6);
- spurious narrow bandwidth components (Sub-clause 8.4);
- spurious transmitter noise (Sub-clause 8.5), and
- inter-transmitter intermodulation products (Clause 11).

Measurements are normally made at the antenna terminals. Additional measurements may be made at the audio, control and power terminals using specified terminations.

8.2 Rated radio-frequency output power

8.2.1 Definition

The peak envelope power (P_p) specified by the manufacturer which, under specified conditions of operation, should be available at the transmitter output terminals when the latter are connected to a specified load.

8.2.2 Method of measurement

NOTE This measurement is frequently made in conjunction with the measurement of the relative intermodulation product level (Clause 14) and ratio of carrier power to rated r.f. output power (Sub-clause 8.3).

8.2.3 Method of measurement for emission Class A3A or A3J

- a) Connect the equipment as illustrated in Figure 7, page 16. Apply audio-frequency signals of 1 000 Hz and 1 600 Hz from generators (2) and (6).
- b) Adjust the level of each audio-frequency signal according to the manufacturer's instructions, to produce two necessary sidebands of equal level.
- c) Measure the average output power. Any convenient method which gives an accuracy of at least $\pm 10\%$, for example a radio-frequency wattmeter, may be used.
- d) For emission type A3J, the rated radio-frequency output power is twice the value measured in step c).

For emission type A3A, where carrier power is 8.5 dB below the level of either necessary sideband, the rated radio-frequency output power is 2.64 times the value measured in step c).

8.2.4 Method of measurement for emission Class A3H

- a) Apply a signal of 1 000 Hz from one of the generators of Figure 7.
- b) Adjust the level of the audio-frequency signal according to the manufacturer's instructions, to produce a necessary sideband having the same level as the carrier.
- c) Measure the average output power. Any convenient method which gives in accuracy of at least $\pm 10\%$, for example a radio-frequency wattmeter, may be used.
- d) The rated radio-frequency output power is twice the value measured in step c).

8.3 Ratio of carrier power to the rated radio-frequency output power (carrier suppression)

8.3.1 Definition

The ratio of:

- a) the transmitter output power in the absence of any intentional modulating signal
to
- b) the rated radio-frequency output power.

8.3.2 Method of measurement

- a) Adjust the transmitter to produce the rated radio-frequency output power according to Sub-clause 8.2.
- b) Remove the audio-frequency modulation and record the carrier power.
- c) The ratio of the carrier power to the rated radio-frequency output power is the ratio of the power recorded in step b) to the power recorded in Sub-clause 8.2.3, step d) or in Sub-clause 8.2.4, step d), expressed in decibels.

8.4 Spurious narrow-bandwidth radio-frequency components

8.4.1 Definition

Spurious narrow-bandwidth radio-frequency components include harmonic and non-harmonic components and parasitic components that are usually characterized by a signal having a dominant component at a discrete frequency or in a narrow band of frequencies.

Components in the immediate vicinity of the necessary band, which are the result of the modulation process for the transmission of information, are excluded.

8.4.2 Method of measurement

- a) Connect the equipment as illustrated in Figure 2, page 5.
- b) With the transmitter modulated by standard test modulation (A), adjust the frequency of the selective voltmeter (10) to the transmitter dominant frequency component and adjust the band rejection filter (8) to produce a minimum deflection of the selective voltmeter.
- c) Adjust the frequency of the selective voltmeter to the first spurious narrow-bandwidth component. Record its level and frequency.
- d) Repeat the measurements for each spurious narrow-bandwidth component in the specified frequency range.

Calibration procedure

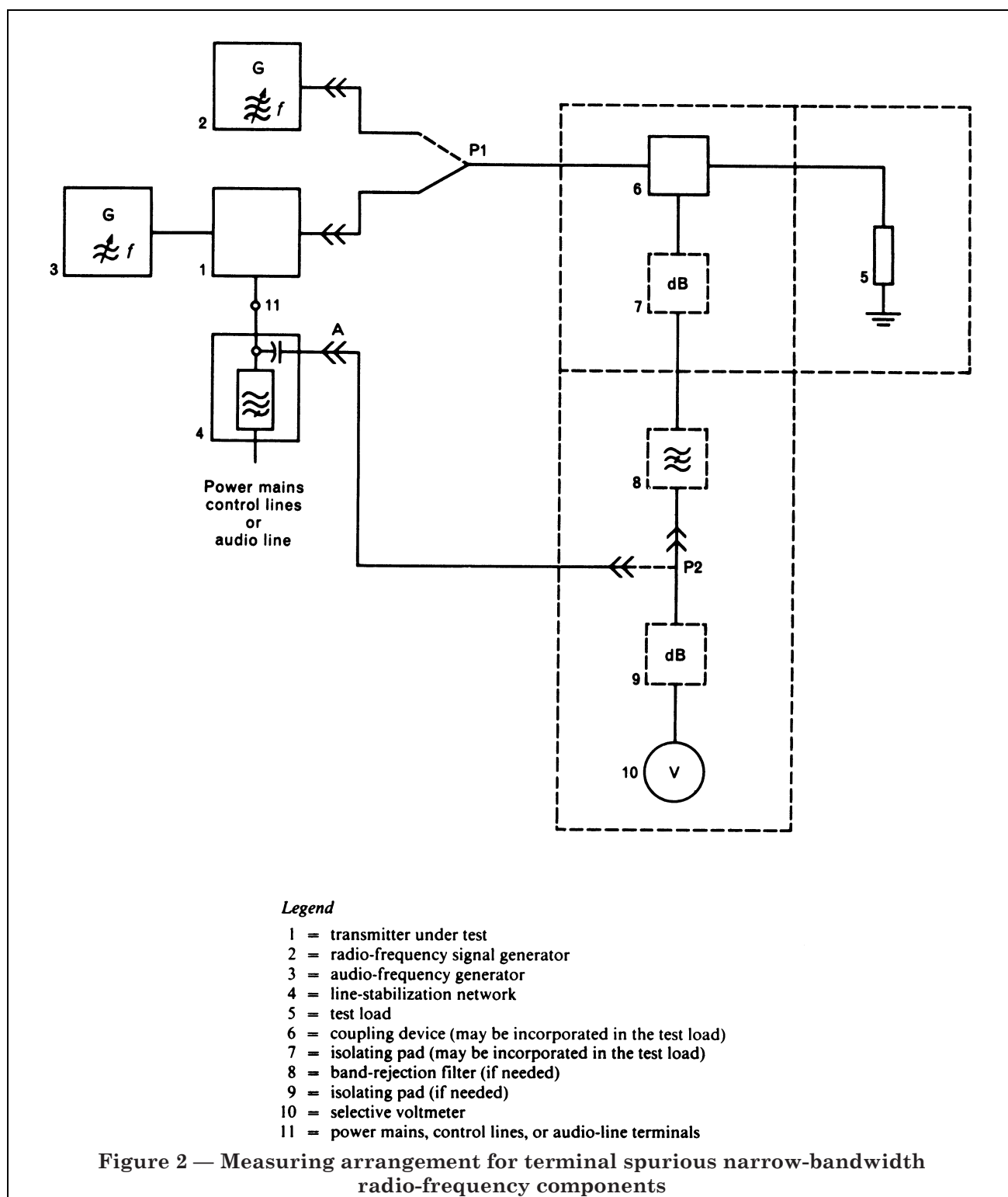
If the absolute power level of each of these spurious emissions needs to be known, calibrate the equipment as follows:

- e) Replace the transmitter by the auxiliary generator (2) at point (P1), and adjust it to operate successively at the centre frequency of each of the spurious narrow-bandwidth components. At each frequency, adjust the auxiliary generator output and the scale of the selective voltmeter, as necessary, to obtain the same reading as recorded in steps c) and d) or a known ratio thereof. Record this ratio, the generator output voltage, the scale change and the input impedance of the measuring arrangement.
- f) Calculate the power of the spurious narrow bandwidth radio-frequency components from the values recorded in step e).

8.4.3 Method of measurement at the audio, control or power terminals for frequencies below 30 MHz

a) Connect the equipment as illustrated in Figure 2, with the selective voltmeter connected to the radio-frequency output terminals (A) of the line-stabilization network.

NOTE An example of a mains power line stabilization network suitable for use on the mains power line is given in Appendix C. Particular attention should be given to the impedance at terminal (A) of Figure 2 as mentioned in Appendix C.



- b) With the transmitter modulated by standard test modulation (A), adjust the selective voltmeter to the frequency of the narrow-bandwidth radio-frequency component to be measured. Record the frequency and the voltage of each measured component along with the input impedance of the selective voltmeter.

8.4.4 Presentation of results

The values recorded in Sub-clause 8.4.2 should be expressed as absolute power and/or as a ratio, in decibels, relative to the rated radio-frequency output power, for each narrow-bandwidth radio-frequency component that is measured.

The values recorded in Sub-clause 8.4.3 b) should be expressed in volts, specifying the test circuit used. Record the rated radio-frequency output power measured in Sub-clause 8.2.

8.5 Spurious transmitter noise

8.5.1 General

Spurious transmitter noise which falls within the bandwidth of any receiver may degrade its performance. The methods of measurement provide for assessing the transmitter noise in terms of:

- a) the attenuation required to avoid more than a specified degradation of receiver performance, or
- b) the spectral power density, which may be used more generally.

NOTE This method of measurement may not be suitable for certain types of impulsive noise.

8.5.2 Definition

Spurious transmitter noise is the continuous spectrum of noise components present at the transmitter output terminals.

8.5.3 Method of measurement

- a) Connect the equipment as illustrated in Figure 3, page 7.
- b) With the transmitter not operating, apply a standard input signal, as defined in IEC Publication 489-5, to ports b) and d) of the matching and combining network (6).
- c) Adjust signal generator (7) and generator (10), if used, to produce standard test modulation in a frequency band displaced from the transmitter operating band by Δf , for example 10 kHz. Adjust the receiver to receive this signal.

NOTE A single-sideband generator may be used instead of the generators (7) and (10). Measurements on A3H emissions need only generator (7).

- d) Adjust the receiver input signal level to a value that is 3 dB greater than reference sensitivity.
- e) With the transmitter modulated by standard test modulation (A), adjust attenuator (4) to reduce the signal-to-noise ratio at the receiver output terminals to the standard value (12 dB SINAD). Record the values of attenuation of attenuator (4) and of the matching or combining network between ports a) and c).
- f) Record the value of the reference sensitivity of the test receiver.
- g) The measurements should be repeated at other values of Δf above and below the nominal carrier frequency.