

Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band —

Part 1: Radio-frequency measurements on outdoor units

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- British Telecommunications plc
- Consumers' Association
- Institution of Electrical Engineers
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- Radio, Electrical and Television Retailers' Association
- Radiocommunications Agency

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National foreword

This Part of BS EN 61079 has been prepared by Technical Committee EPL/12 and is the English language version of EN 61079-1:1993 *Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band — Part 1: Electrical measurements on outdoor units* published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1079-1:1992, published by the International Electrotechnical Commission (IEC).

BS EN 61079 is a multipart standard. The other Parts published to date are:

- *Part 2:1995: Electrical measurements on DBS tuner units;*
- *Part 3:1995: Electrical measurements of overall performance of receiver systems comprising an outdoor unit and a DBS tuner unit;*
- *Part 5:1995: Electrical measurements on decoder units for MAC/packet systems.*

This Part of BS EN 61079 defines the conditions and methods of measurement to be applied to the outdoor unit of a receiver for the direct reception of satellite broadcast transmissions in the 12 GHz band. The channels are those defined by WARC BS-77 and RARC SAT-83 and the systems are those defined in CCIR Recommendation 650. Performance requirements are not specified.

Cross-references

Publications referred to	Corresponding British Standard
IEC 107-1:1977	BS 3549 <i>Methods of measuring and expressing the performance of television receivers</i> Part 1:1979 <i>General considerations and electrical measurements other than those at audio-frequencies</i>
EN 61079-2:1993 (IEC 1079-2:1992)	BS EN 61079-2 <i>Methods of measurements on receivers for satellite broadcast transmissions in the 12 GHz band</i> Part 2:1995 <i>Electrical measurements on DBS tuner units</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 36, 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.

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English version

Methods of measurement on receivers for satellite
broadcast transmissions in the 12 GHz band
Part 1: Radio-frequency measurements on outdoor units

(IEC 1079-1:1992)

Méthods de mesure sur les récepteurs
d'émissions de radiodiffusion par satellite
dans la bande 12 GHz
Partie 1: Mesures en radiofréquence sur le
matériel extérieur
(CEI 1079-1:1993)

Meßverfahren für Empfänger für
Satellitenrundfunk-Übertragungen im
12-GHz-Bereich
Teil 1: Radiofrequenz-Messungen an der
Außeneinheit
(IEC 1079-1:1992)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

At the request of the 73rd CENELEC Technical Board, the International Standard IEC 1079-1:1992 was submitted to the CENELEC Unique Acceptance Procedure (UAP) in November 1992 for acceptance as a European Standard.

The text of the International Standard was approved by CENELEC as EN 61079-1 on 22 September 1993.

The following dates were fixed:

- latest date of publication
of an identical national
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of conflicting national
standards (dow) 1994-09-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex A is informative, and Annex ZA is normative.

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Section 1. General

1.1 Scope

This International Standard applies to the outdoor unit of a receiver for the direct reception of satellite broadcast transmissions in the 12 GHz band. The channels are those defined by WARC BS-77 and RARC SAT-83 and the systems are those defined in CCIR Recommendation 650.

The object of this standard is to define the conditions and methods of measurement to be applied. The standard does not specify performance requirements.

An outdoor unit normally comprises three main parts, the antenna, the depolarizer and optional orthomode transducer (OMT), and the SHF converter as defined in clause 1.3. The methods of measuring the electrical properties described in this part of the standard apply particularly to the outdoor unit or the SHF converter.

Methods of measurement on the associated DBS tuner unit are described in Part 2 of this standard.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication of this standard, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 107-1:1977, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 1: General considerations — Electrical measurements other than those at audio-frequencies.*

IEC 1079-2:1992, *Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band — Part 2: Electrical measurements on DBS tuner units.*

1.3 Definitions

For the purpose of this International Standard, the following definitions apply.

The outdoor unit is a part of the receiver for satellite broadcast transmissions in the 12 GHz band, and comprises three main parts:

- a) the antenna including the feed horn which receives the signals broadcast by satellites;
- b) the depolarizer that converts circular polarization to linear polarization and an optional orthomode transducer, OMT, which separates two incoming differently polarized signals into two independent SHF outputs;
- c) the SHF converter [also called low noise converter (LNC) or low noise block converter (LNB)], which is a device to convert the received signals in the 12 GHz band to intermediate frequencies (often called the first i.f.) usually in the range of approximately 1 GHz to 2 GHz, for application to one or more DBS tuner units, where demodulation and decoding of the received signals are performed.

Section 2. General notes on measurement

2.1 General conditions

2.1.1 Introduction

Measurements shall be made in accordance with the following conditions to ensure reproducible results. The methods described here assume the use of the following transmission systems: digital sub-carrier/NTSC, B-MAC, C-MAC/packet, D-MAC/packet and D2 MAC/packet. Information pertaining to these systems may be found in the references listed in the bibliography given in Annex A.

2.1.2 Test site

Measurements shall be carried out at a location that is not subject to external interference from radio frequency energy. If interference cannot be avoided, the measurements shall be carried out in a screened room.

2.1.3 Environmental conditions

Sections 3, 4 and 5 of IEC 107-1 shall be applied.

2.1.4 Power supply

2.1.4.1 Bias network

When measuring the characteristics of an outdoor unit, it is necessary to supply d.c. or a.c. power to it without influencing the output signal. For this purpose, a bias network such as that shown in Figure 1 can be used.

NOTE Reverse connection of the bias network (see Figure 2) is likely to cause damage.

2.1.4.2 Nominal voltage

The d.c. or a.c. voltage to be applied to the unit during the test shall be within $\pm 2\%$ of the nominal operating voltage, unless otherwise specified.

Where only a range of voltages is specified, the nominal voltage shall be taken as the mean value of this range. Measurements shall be repeated at the limits of the specified range, as indicated in the following clauses.

2.1.5 Other conditions

2.1.5.1 Accuracy of the measuring instruments

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

2.1.5.2 Stabilization period

The characteristics of an outdoor unit may change for some period after the application of supply voltage. Unless otherwise specified, measurements should be started after the stabilization of the characteristics is obtained.

2.2 Radio-frequency input signals

2.2.1 Introduction

The following input signals shall be used.

2.2.2 Test signals

Unless otherwise specified, continuous wave (c.w.) radio-frequency (r.f.) signals shall be used.

2.2.3 Test frequencies

Unless otherwise specified, test frequencies shall be selected near the nominal carrier frequency of each broadcast channel, as specified by the standards of the country or countries in which the equipment is intended for use.

2.2.4 Radio-frequency input arrangement

Depending on the input facilities of the equipment under test, the radio-frequency input signal can be applied in three different ways:

- a) by means of a waveguide, having a flange and a cross-section compatible with the input of the unit;
- b) by means of a coaxial cable and a connector compatible with the input of the unit;
- c) by means of a transmitting antenna generating a field of wanted level at the receiving antenna which provides the electrical input signal for the unit.

When two or more signals are to be applied (two or multi-signal measuring methods), suitable combining networks, such as hybrid networks or directional couplers with the specified characteristic impedance shall be used to connect the various signal generators. All unused terminals shall be terminated with matched loads.

When input arrangement indicated in c) is used, the signals of the various generators are combined before application to the transmitting antenna.

NOTE Any type of hybrid such as magic tee, rat-race or hybrid-ring can be used.

2.2.5 Input signal level

The input signal level to an outdoor unit shall be expressed according to the input arrangement used (see 2.2.4).

2.2.5.1 Available power

With the input arrangement a) or b) of 2.2.4, the input signal level is expressed in terms of available power at the output of the signal generator, including its associated network.

The available power is the power delivered by the signal generator to a matched load. It is expressed in milliwatts and can be calculated by the following formula:

$$P = \frac{E_g^2}{4R_g} \text{ (mW)}$$

where

P = available power (mW);

E_g = electromotive force at the output terminal of the signal generator (V);

R_g = output resistance of the signal generator (Ω).

2.2.5.2 Power flux density

With input arrangement c) of 2.2.4, the input signal level is expressed in terms of power flux density (PFD) at the aperture plane of the receiving antenna, calculated as follows:

$$PFD = \frac{P_A G}{4\pi d^2} \text{ (W/m}^2\text{)}$$

where

P_A = power delivered by the signal generator to the input of the transmitting antenna (W);

G = gain of the transmitting antenna in the direction towards the receiving antenna;

d = distance between the transmitting antenna and the receiving antenna (m), measured between the electrical centres.

2.2.5.3 Siting of the antennas

The antennas shall be placed at least 4 m above ground level to lessen the interference by the reflected wave from the ground. When a slant antenna range¹⁾ setting (see Figure 3) is used, the transmitting antenna can be placed on the ground while the receiving antenna is placed at the top of a tower.

To avoid measurement errors caused by a non-uniform distribution of spherically propagated electromagnetic waves, the distance between the transmitting and the receiving antennas should be larger than $2 D_1^2/\lambda$ and $D_1 D_2/0,32 \lambda$, where D_1 and D_2 are the maximum diameters of the antenna under test and the transmitting antenna respectively, and λ is the free space wavelength at the test frequency. If the electric field strength at the receiving point deviates more than $\pm 0,5$ dB in the aperture plane, the height and the distance shall be rearranged to obtain a deviation smaller than $\pm 0,5$ dB. The method of measuring the electric field strength at the receiving point is mentioned in clause 3.8.

Section 3. Measuring methods

3.1 Polarization isolation

3.1.1 Introduction

This method of measurement determines the isolation between the two independent and differently polarized signals entering the outdoor unit measured at the output of the complete outdoor unit.

¹⁾ For a slant antenna range, the following paper can be referred to: P.W. Arnold, *The slant antenna range*, IEEE Trans. Antennas & Propag., AP-14. 5 pp. 658–659 (1966).

NOTE According to CCIR recommendations, the polarization of the signals is right hand or left hand circular.

3.1.2 Method of measurement

A test signal is applied to the input terminal of the outdoor unit and the resulting output, from one of the SHF converters, is measured at specified frequencies. The polarization of the input signal is reversed by appropriate means and the resulting new output level is recorded. The polarization isolation is determined from the level difference between the two measurements. The arrangement of the test equipment is shown in Figure 4. Only input arrangement c) (see 2.2.4) can be used to perform this measurement which should be made according to the following conditions and procedure.

3.1.2.1 Measuring conditions

- a) Test frequency: the centre frequency of the lowest (L), the mid (M) and the highest (H) channels in the 12 GHz broadcasting band.
- b) Test signal level at the input (12 GHz band): $-94 \text{ dB(W/m}^2\text{)}$.

3.1.2.2 Measurement procedure

- a) A c.w. signal at the specified test signal level is applied to the input terminal of the outdoor unit.
- b) The output signal level of the outdoor unit (at the bias network output terminal) is measured: $L_{P1} \text{ dB(mW)}$.
- c) The polarization of the input signal is reversed by appropriate means.
- d) The new output signal level of the outdoor unit is measured: $L_{P2} \text{ dB(mW)}$.
- e) Polarization isolation ($L_{P\text{isol}}$) is:

$$L_{P\text{isol}} = L_{P1} - L_{P2} \text{ (dB)}$$
- f) The test signal frequency is changed and steps a) to e) are repeated.
- g) The other output terminal is taken into consideration by connecting the bias network and spectrum analyzer to it while terminating the previous output terminal with a matched load.
- h) Steps a) to f) are repeated with this new output terminal.

3.1.3 Presentation of the results

The results shall be listed in a table and/or presented graphically.

3.2 Impedance matching at the input terminal

3.2.1 Introduction

This method of measurement determines the impedance matching at the input terminal of the SHF converter. It is applicable only to input arrangement a) or b) (see 2.2.4).

3.2.2 Method of measurement

A test signal is applied to the input terminal of the outdoor unit and the levels of the direct signal and reflected signal at the terminal are measured using a directional coupler. The return loss is the level difference between these two signals. The arrangement of the test equipment is shown in Figure 5. The measurement should be made according to the following conditions and procedure.

3.2.2.1 Measuring conditions

- a) Test frequency: the centre frequency of each channel in the reception band (12 GHz).
- b) Test signal level: -70 dB(mW) .

3.2.2.2 Measurement procedure

- a) A c.w. signal is applied and the variable attenuator adjusted to obtain the recommended signal level at the output terminal of the directional coupler.
- b) With a short-circuit termination placed at the output terminal of the directional coupler, the output signal level of the amplifier $L_{Po} \text{ [dB(mW)]}$ is measured.
- c) The SHF converter input terminal is connected to the directional coupler output terminal and the amplifier output signal level $L_p \text{ [dB(mW)]}$ is measured.
- d) The return loss is expressed as the difference:

$$L_{Po} - L_p \text{ (dB)}$$
- e) The test signal frequency is changed and steps a), b), c) and d) are repeated.

NOTE The amplifier shall be sufficiently linear not to influence the results within the range of the signal levels used.

3.2.3 Presentation of the results

The results shall be listed in a table and/or presented graphically.

3.3 Impedance matching at the output terminal

3.3.1 Introduction

This method of measurement determines the impedance matching at the output terminal of the outdoor unit.

3.3.2 Method of measurement

A test signal is applied to the output terminal of the outdoor unit and the levels of the direct signal and reflected signal at the terminal are measured using a SWR bridge. The return loss is the level difference between these two signals. The arrangement of the test equipment is shown in Figure 6. The measurement shall be made according to the following conditions and procedure.

3.3.2.1 Measuring conditions

- a) Test frequency: the centre frequency of each channel in the i.f. band.
- b) Test signal level: -30 dB(mW).

3.3.2.2 Measurement procedure

- a) The input terminal is terminated with a matched load when input arrangement a) or b) (see 2.2.4) is used. Otherwise, when input arrangement c) (see 2.2.4) is used, the outdoor unit antenna shall be oriented towards the sky, avoiding any satellite reception.
- b) A c.w. signal is applied and the variable attenuator is adjusted to obtain the recommended signal level at the output terminal of the SWR bridge.
- c) A short-circuit termination is placed at the test terminal of the SWR bridge and the output signal level of the SWR bridge L_{P_0} [dB(mW)] is measured.
- d) The output terminal of the outdoor unit is connected to the SWR bridge test terminal and the output signal level of the SWR bridge L_P [dB(mW)] is measured.
- e) The return loss is expressed as the difference: $L_{P_0} - L_P$ (dB).
The insertion loss and SWR of the bias network shall be known and taken into account in the measurement result.
- f) The test signal frequency is changed and steps b), c), d) and e) are repeated.

3.3.3 Presentation of the results

The results shall be listed in a table and/or presented graphically.

3.4 Gain frequency characteristics

3.4.1 Introduction

This method of measurement determines the gain variation within a channel and between channels in the reception band.

3.4.2 Method of measurement

A constant level of test signal is applied to the input terminal and the corresponding output signal level is measured at specified frequencies. The arrangement of the test equipment is shown in Figure 7 when input arrangement a) or b) (see 2.2.4) is used, and in Figure 8 when input arrangement c) (see 2.2.4) is used. The measurement shall be made according to the following conditions and procedure.

3.4.2.1 Measuring conditions

- a) Test frequency: the centre frequency of each allocated channel in the 12 GHz broadcasting band.
- b) Test signal level: -70 dB(mW) when input arrangement a) or b) is used, or -94 dB(W/m²) when input arrangement c) is used.
- c) Seven points are measured every 5 MHz within ± 15 MHz of the centre frequency in each channel.