

Methods of measurement for equipment used in digital microwave radio transmission systems —

**Part 1: Measurements common to
terrestrial radio-relay systems and
satellite earth stations —**

Section 1.2 Basic characteristics

The European Standard EN 60835-1-2:1993 together with its amendment A1:1995, has the status of a British Standard

ICS 33.060.30

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Electronic Equipment Standards Policy Committee (EEL/-) to Technical Committee EEL/25, upon which the following bodies were represented:

- British Broadcasting Corporation
- British Radio and Electronic Equipment Manufacturers' Association
- British Telecommunications plc
- Institution of Electrical Engineers
- Radio, Electrical and Television Retailers' Association
- Radiocommunications Agency

The following body was also represented in the drafting of the standard, through subcommittees and panels:

ERA Technology Ltd.

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National foreword

This Section of BS EN 60835 has been prepared by Technical Committee EPL/102 (formerly EEL/25), and is the English language version of EN 60835-1-2:1993 *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 1: Measurements common to terrestrial radio-relay systems and satellite earth stations — Section 2: Basic characteristics*, including amendment A1:1995, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 835-1-2:1992, including amendment No. 1:1995, published by the International Electrotechnical Committee (IEC).

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.

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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 20 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 for equipment used in digital
microwave radio transmission systems
Part 1: Measurements common to terrestrial radio-relay
systems and satellite earth stations
Section 2: Basic characteristics

(includes amendment A1:1995)
(IEC 835-1-2:1992 + A1:1995)

Méthodes de mesure applicables au matériel
utilisé pour les systèmes de transmission
numérique en hyperfréquence
Partie 1: Mesures communes aux faisceaux
hertziens terrestres et aux stations terriennes
de télécommunications par satellite
Section 2: Caractéristiques de base
(inclut l'amendement A1:1995)
(CEI 835-1-2:1992 + A1:1995)

Meßverfahren für Geräte in digitalen
Mikrowellen-Funkübertragungssystemen
Teil 1: Messungen an terrestrischen
Richtfunksystemen und
Satelliten-Erdfunkstellen Hauptabschnitt 2:
Grundlegende Eigenschaften
(enthält Änderung A1:1995)
(IEC 835-1-2:1992 + A1:1995)

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

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Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 835-1-2:1992 could be accepted without textural changes, has shown that no common modifications were necessary for the acceptance as a European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 60835-1-2 on 6 July 1993.

The following dates were fixed:

- latest date of publication
of an identical national
standard (dop) 1994-08-01
- latest date of withdrawal
of conflicting national
standards (dow) 1994-08-01

Foreword to amendment A1

The text of document 12E(CO)164, future amendment 1 to IEC 835-1-2:1992, prepared by SC 12E, Radio-relay and satellite communications systems, of IEC TC 12, Radiocommunications, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60835-1-2:1993 on 1995-03-06.

The following dates were fixed:

- latest date by which the
amendment has to be
implemented at national
level by publication of an
identical national standard
or by endorsement (dop) 1996-03-01
- latest date by which the
national standards
conflicting with the
amendment have to be
withdrawn (dow) 1996-03-01

Introduction

Modern test sets often combine a number of different measurement functions under the control of a microprocessor. In this way generally more than one parameter is checked and analysed step-by-step in accordance with specific software programmes.

The results of the measurements are printed or plotted automatically and the programme description and tolerance analysis form part of the presentation of results. An example of such specialized equipment is a network analyser which combines two and four-port measurement facilities in one microprocessor-controlled unit.

1 Scope

This section of IEC 835-1 deals with the measurement of basic characteristics common to terrestrial radio-relay systems and satellite earth stations. These basic characteristics apply to all of the frequency ranges employed in the radio systems, i.e:

- radio frequency;
- intermediate frequency;
- baseband (e.g. clock frequency of the digital baseband signal).

The method of measurement for each parameter (e.g. return loss) is presented, wherever possible, as a single clause which is applicable to any of the above frequency ranges. Where exceptions occur, they will be given in the relevant clauses.

2 Carrier frequency

2.1 Definition and general consideration

The carrier frequency is that frequency in the r.f. signal spectrum which is modulated by the information, or baseband, signal. The carrier frequency is normally measured without modulation. If energy dispersal is employed, it should be rendered inoperative, if possible, before making measurements.

2.2 Methods of measurement

The arrangement for measuring frequency using a counter or digital frequency-meter is shown in Figure 1. The band-pass filter is required only if spurious signals are present. The amplifier and/or attenuator are required only if the input range of the frequency-meter does not cover the range of levels concerned.

Both the equipment under test and the test equipment itself should be allowed to attain thermal stability before making any measurements.

The digital frequency-meter indications are then read during an interval of, for example, one second, depending upon the integrating time of the instrument used.

Alternatively, a recorder may be used to record the indications of the digital frequency-meter for a number of counts. The number of counts will depend upon whether noise is present or not, and whether this modulates the signal or is superimposed upon it.

Generally, the analysis of a statistical series averaged over several measuring intervals will provide evidence of the repeatability of the results.

NOTE The above method may also be used when the r.f. carrier is modulated by a zero mean baseband signal, provided that the digital frequency-meter does not introduce errors which depend upon the modulating signal. The averaging interval of the digital frequency-meter should exceed 100 cycles of the modulating signal. Alternatively, e.g. when performing frequency measurements on baseband signals, where a long time is required (10 s or more), several counter readings with a short averaging time can be taken and the average of these readings calculated.

There are also other methods applicable for carrier frequency measurement with modulation. For example, the substitution or interference method using a spectrum analyser as an indicator in conjunction with a synthesizer as a reference frequency source.

2.3 Presentation of results

The readings of the digital frequency-meter should be recorded manually or automatically as a function of time. The integrating time and the accuracy of the digital frequency-meter should be stated. When several counter readings are taken they should be tabulated, together with the calculated average value.

The measured accuracy can be expressed as an absolute value, e.g. 50 kHz, or as a fractional value, e.g. one part in 10^{-5} . The nominal carrier frequency should also be stated.

2.4 Details to be specified

The following items should be included, as required, in the detailed equipment specification:

- a) nominal value of frequency and required accuracy;
- b) the part of the equipment to be measured and the port at which the measurement is to be made;
- c) permitted frequency tolerance.

3 Spectrum

It is necessary to evaluate the spectrum which is to be transmitted by the radio-relay or satellite earth station in terms of wanted or unwanted signals. Wanted signals within the necessary bandwidth are treated under “signal spectrum”, and unwanted signals which appear outside the necessary bandwidth are treated under “spurious emissions”.

3.1 Signal spectrum

3.1.1 Definitions and general considerations

In accordance with reference 1 the spectrum of a modulated signal is defined by the following characteristics:

- necessary bandwidth;
- occupied bandwidth;
- out-of-band signal;
- unwanted spectrum components.

The *necessary bandwidth* is a theoretical value which ensures that the information will be transmitted with the required quality, whereas the *occupied bandwidth* is a measurable value within which a specified percentage of the total power of a given signal should lie (e.g. 99 %).

The *out-of-band signal* is that part of the signal which is outside the necessary bandwidth and results from the modulation process and/or caused by spectral restoration or spectral spreading.

Unwanted spectrum components within the necessary bandwidth are also measured.

NOTE Unwanted components with an inadmissibly high level in the transmitted signal usually adversely affect the error ratio. These components therefore have a different significance in digital systems than in analogue systems.

3.1.2 Methods of measurement

A suitable measuring arrangement is shown in Figure 2.

To measure the spectrum of the modulated signal, a random bit sequence modulation may be applied. This bit sequence is usually generated by a pseudo-random generator (e.g. a sequence of $2^{23} - 1$ bits for 140 Mbit/s systems). The resolution bandwidth of the analyser should be greater than the bit rate of the pseudo-random bit sequence by a factor of 50 to 100 [e.g. for a bit rate of 34 Mbit/s and a sequence of $2^{15} - 1$ bits, the resolution bandwidth is $(50 : 100) \times 34 \cdot 10^6 / (2^{15} - 1)$, approximately 50 : 100 kHz].

To measure the level of the unwanted components within the necessary bandwidth it is necessary to operate the equipment under test without modulation.

3.2 Spectrum of spurious components

3.2.1 Definition and general considerations

According to the Radio Regulations, a spurious emission is an emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, *but exclude out-of-band emissions*.

Unwanted signal components may be divided into two categories:

- i) *Spurious components* excluding intermodulation products but including:
 - harmonic signals;
 - parasitic signals;
 - frequency conversion products.