

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

Part 2: Measurements on terrestrial radio-relay systems —

Section 2.4 Transmitter/receiver including modulator/demodulator

The European Standard EN 60835-2-4:1995 with the incorporation of amendment A1:1997 has the status of a British Standard

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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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Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
Foreword	2
Introduction	3
1 Scope	3
2 Normative references	3
3 Transmitter including modulator	4
4 Receiver including demodulator	5
5 Transmit-receive section	7
Annex A (informative) Bibliography	17
Annex ZA (normative) Other international publications quoted in this standard with the references of the relevant European publications	18
Figure 1 — Examples of signal processors used in digital transmitters and receivers	10
Figure 2 — Arrangement for measuring the selectivity of the carrier part of a digital receiver	11
Figure 3 — Arrangement for measuring the transmission performance of a digital transmit/receive section under flat-fading conditions	12
Figure 4 — Example of a bit-error-ratio curve of a digital transmit/receive section as a function of receiver input level (simulated flat-fading)	13
Figure 5 — Functional arrangement of the fading simulator	14
Figure 6 — Wideband frequency characteristic of the two-ray i.f. fading simulator	14
Figure 7 — Example of minimum/non-minimum phase signature	15
Figure 8 — Arrangements for measuring the group-delay/frequency characteristic of a digital transmit/receive section	16
List of references	Inside back cover

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 60835-2-4:1995, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 2: Measurements on terrestrial radio-relay systems — Section 4: Transmitter/receiver including modulator/demodulator*, including amendment A1:1997, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 835-2-4:1993, published by the International Electrotechnical Committee (IEC).

Cross-references

Attention is drawn to the fact that Annex ZA lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or using the “Find” facility of the BSI Standards Electronic Catalogue.

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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 18, 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 for equipment used in digital
microwave radio transmission systems
Part 2: Measurements on terrestrial radio-relay systems
Section 4: Transmitter/receiver including
modulator/demodulator

(IEC 835-2-4:1993)
(includes amendment A1:1997)

Méthodes de mesure applicables au matériel
utilisé pour les systèmes de transmission
numérique en hyperfréquence
Partie 2: Mesures applicables aux faisceaux
hertziens terrestres
Section 4: Émetteur/récepteur,
modulateur/démodulateur inclus
(CEI 835-2-4:1993)
(inclut l'amendement A1:1997)

Meßverfahren für Geräte in digitalen
Mikrowellen-Funkübertragungssystemen
Teil 2: Messungen an terrestrischen
Richtfunksystem
Hauptabschnitt 4: Sender/Empfänger
einschließlich Modulator/Demodulator
(IEC 835-2-4:1993)
(enthält Änderung A1:1997)

This European Standard was approved by CENELEC on 1994-12-06 and amendment A1 was approved on 1997-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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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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 text of the International Standard IEC 835-2-4:1993, prepared by SC 12E, Radio-relay and fixed satellite communications systems, of IEC TC 12, Radiocommunications, was submitted to the formal vote and was approved by CENELEC as EN 60835-2-4 on 1994-12-06 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1995-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1995-12-01

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

Annex ZA has been added by CENELEC.

Foreword to Amendment A1

The text of document 102/8/FDIS, future amendment 1 to IEC 60835-2-4:1993, prepared by IEC TC 102, Equipment used in mobile services and satellite communication systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60835-2-4:1997 on 1997-10-01.

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) 1998-08-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1998-08-01

Endorsement notice

The text of amendment 1:1997 to the International Standard IEC 60835-2-4:1993 was approved by CENELEC as an amendment to the European Standard without, any modification.

Introduction

Several types of modulation may be used for the transmission of the main digital signal. Of these, only measurements applicable to systems using phase modulation or phase and amplitude modulation, e.g. PSK and n-QAM, will be covered in this section of IEC 835-2, since these modulation types are employed in the majority of digital radio-relay systems.

The digital transmitter is preceded by a transmit signal processor which modifies the multiplexed digital to facilitate radio transmission. Similarly, the receiver is followed by a receive signal processor in order to recover the digital signal. Measurements on these signal processors are dealt with in IEC 835-2-5, but in order to clarify their main functions and interconnection points in transmitter/receiver measurements, examples are given in Figure 1. A further function of signal processors, not shown in Figure 1, may be the combination and separation of more than one bit-stream.

The interconnection points between the transmit processor and modulators and also between the receive processor and demodulator are not always accessible.

Digital transmitter and receiver measurements are conveniently grouped into three parts for testing; measurements on transmitters including modulators are given in 3, measurements on receivers including demodulators in clause 4, whilst clause 5 deals with transmit-receive section (or "hop") measurements. For some of the parameters, only those aspects related to the fact that the measurement is carried out on a transmitter or receiver are given, and reference is made to other sections of IEC 835-2 for detailed methods of measurements.

All measurements should be carried out under specified environmental conditions, such as temperature and humidity, in accordance with IEC 835-2-1.

1 Scope

This Section of IEC 835-2 deals with methods of measurement for transmitters including modulators, and receivers including demodulators, used in digital radio-relay systems. Measurements for adaptive equalizers are given in IEC 835-2-8.

Methods of measurement for the a.g.c. characteristic, selectivity and noise figure and receiver local oscillator frequency are generally applicable only when the receiver i.f. output is accessible. This may not be the case for receivers used in systems having a microwave demodulator or a low bit rate, e.g. below 2 Mbit/s.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 835-2. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 835-2 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 835-1-1:1990, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 1: Measurements common to terrestrial radio-relay and satellite earth stations — Section 1: General.*

IEC 835-1-2:1992, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 1: Measurements common to terrestrial radio-relay and satellite earth stations — Section 2: Basic characteristics.*

IEC 835-1-3:1992, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 1: Measurements common to terrestrial radio-relay and satellite earth stations — Section 3: Transmission characteristics.*

IEC 835-1-4:1992, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 1: Measurements common to terrestrial radio-relay and satellite earth stations — Section 4: Transmission performance.*

IEC 835-2-1:1990, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 2: Measurements on terrestrial radio-relay systems — Section 1: General.*

IEC 835-2-5:1993, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 2: Measurements on terrestrial radio-relay systems — Section 5: Digital signal processing subsystem.*

IEC 835-2-8:1993, *Methods of measurement for equipment used in digital microwave radio transmission systems — Part 2: Measurements on terrestrial radio-relay systems — Section 8: Adaptive equalizer.*

CCIR Recommendation 556, *Hypothetical reference digital path for radio-relay systems which may form part of an integrated services digital network; systems with a capacity above the second hierarchical level.*

CCIR Recommendation 557, *Availability objective for a hypothetical reference circuit and a hypothetical reference digital path.*

CCIR Recommendation 594, *Allowable bit error ratios at the output of the hypothetical reference digital path for radio-relay systems which may form part of an integrated services digital network.*

CCITT Recommendation O.151, *Specification for instrumentation to measure error performance on digital systems.*

CCITT Recommendation G.703, *Physical/electrical characteristics of hierarchical digital interfaces.*

3 Transmitter Including modulator

3.1 General

Examples of digital transmitters with r.f. and i.f. modulators are given in IEC 835-1-1.

In multi r.f. channel systems, the transmitting filter, although it may be a part of the branching system, should be included in the transmitter measurements, i.e. the r.f. output of the transmitter is regarded as the output from this filter.

Measuring instruments should be connected either to this point or, if available, to an equivalent test point. During all of the measurements to be described, only the transmitter under test should be in operation and all other transmitters of the multi-channel system should be switched off.

Measurements related to the output port of the i.f. modulator, if applicable, are not included. Nevertheless, such measurements may be required for i.f. modulators.

3.2 Output frequency

See IEC 835-1-2.

The frequency meter is connected via a suitable r.f. attenuator to the transmitter output. Modulation should be disabled to obtain a c.w. carrier.

3.3 R.F. output spectrum

See IEC 835-1-2.

The spectrum analyser is connected via a suitable r.f. attenuator to the transmitter output and three measurements are carried out.

Firstly, the modulation process is disabled to obtain a c.w. carrier, and the spectral purity of the unmodulated carrier is measured. The level of unwanted spurious and harmonic spectrum components within a specified frequency range should not exceed specified limits as observed on the calibrated spectrum analyser display.

NOTE In the case where the modulation process is not capable of being disabled, alternative methods of measurement are under consideration.

Next, the modulator is restored to normal and the digital signal input port is driven (via the transmit signal processor, if required) by a pattern generator giving a pseudo-random bit sequence at nominal bit rate to produce a spectrum corresponding to operational conditions. In the case of more than one main bit-stream (e.g. 2×34 Mbit/s), each digital signal input port should be driven separately by sufficiently uncorrelated patterns. This measurement is made to verify that the output spectrum falls within the mask defining the specified limits.

Finally, the output spectrum with the alarm indicating signal (A.I.S.) drive is also observed in order to ascertain whether potential interference requirements are met in this case.

3.4 R.F. output power

See IEC 835-1-2.

The r.f. power meter is connected via a suitable r.f. attenuator to the transmitter output. The r.f. output power is usually defined as the average power of the signal vectors during the digital modulation process.

Therefore, the output power is measured while the digital signal input is driven, via the transmit signal processor, if required, by a pattern generator giving a pseudo-random bit sequence at the nominal bit rate. Care should be taken, especially with transmitters modulated by n-QAM signals, to ensure that all signal states are sufficiently random by using a pattern of adequate length. The pattern lengths given in CCITT Recommendation O.151 for bit-error-ratio (BER) measurements are preferred.

NOTE In PSK systems, output power is sometimes specified for the case where no modulation is applied.

3.5 Phase/amplitude error

3.5.1 Method of measurement

The phases and amplitudes of the modulated output carrier in the individual modulation states are represented by the vectors of the signal space diagram.

The phase and amplitude errors, i.e. the displacement of these vectors from their nominal position, are basic quality parameters of the digital modulator.